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CORRECTIONS

ERA Vol. 1, No. 4, Abst. 4893, line 1 should read: (COO-2500-2) Advanced dry cooling tower concept.

ERA Vol. 1, No. 4, Abst. 4912, line 1 should read: (WAPD-MRP-144) Pressurized Water Reactor Pro-

ERA Vol. 3, No. 6, Abst. 12883, line 1 should read: (CONF-771039-3) Lanthanide (III) and actinide (III) che-

ERA Vol. 3, No. 7, Abst. 15693, line 1 should read: (TID-27795) Rock bed heat accumulators. (Minnesota

ERA Vol. 3, No. 10, Abst. 25221, line 1 should read: (BNL-23637) In-vivo measurement of kidney and liver

ERA Vol. 3, No. 18, Abst. 42289, line 1 should read: (GJBX-11(78)R) NURE 1977 annual activity report.

ERA Vol. 3, No. 18, Abst. 42484, lines 4-6 should read: EY-76-C-02-0016. 12p. (CONF-780249-1). Dep. NTIS, MF A01. From 3. workshop on the use of solar energy for the cooling of buildings; San Francisco, CA, USA (15 Feb 1978).

ERA Vol. 3, No. 18, Abst. 43667, line 1 should read: (COO-2361-2) Labeling pharmaceuticals with radioactive

ERA Vol. 3, No. 20, Abst. 47637, line 1 should read: (NUREG/CR-0052) Evaluation of inspection and en-

ERA Vol. 3, No. 20, Abst. 48578, line 1 should read: (HCP/T2471-18) Industrial application fluidized-bed

ERA Vol. 3, No. 20, Abst. 48691, line 1 should read: (UCRL-81283) Atmospheric statistical dynamic models.

ERA Vol. 3, No. 20, Abst. 48904, line 1 should read: (ORNL-tr-4583) Effect of uranium intoxication on

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Abey, A., *See* Schatz, J., 3:1561
Abey, A.E., Apparatus for deformation tests at intermediate strain rates—10^{-2} to 10^{-2} s^{-1}—and at high pressure, 3:1118 (UCRL–79012)
Abou-Sayed, A.S., *See* Jones, A.H., 3:202

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Volume 3, Number 24, December 31, 1978

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 57068, 57092

PROCESSING

REFER ALSO TO CITATION(S) 56902

CARBONIZATION

REFER ALSO TO CITATION(S) 56377

56326 (FE—1220-33) **Clean Coke process: process development studies. Report for fourth quarter 1977.** (USS Engineers and Consultants, Inc., Pittsburgh, PA (USA)). Feb 1978. Contract EX-76-C-01-1220. 28p. Dep. NTIS, PC A03/MF A01.

The carbonization PDU program on West Kentucky coal has been completed. Duplicate material-balance runs with preoxidized West Kentucky coal were conducted, processing coal at 820°F and the intermediate semichar at 1400°F. Overall accountabilities in the range 98 to 102 percent were obtained on total mass, elemental carbon and sulfur, and on NaOH. Carbonization of West Kentucky coal produced the following yields in weight percent: char (0.75% sulfur)--63.4; tar--11.5; water--4.4; C_1-to-C_4 gas--7.8; hydrogen--0.5; acid gas--11.9; and ammonia--0.4. An initial PDU run with highly caking Pittsburgh Seam coal was completed with no agglomeration problem by using fluidizing gas containing 3 percent oxygen in steam. Free-flowing Pittsburgh semichar was produced in a fluid bed at 860°F and 24 psia and with a 46-minute residence time. Operating conditions for this run were developed and proven satisfactory in the 3-inch bench-scale carbonizer. Final characterization of tar from carbonization of Illinois coal has been completed. Tar from second-stage carbonization of Illinois semichar in the 3-inch unit was processed and analyzed to identify the type and yield of commercially important components in the chemical-oil fraction. Evaluation of formcoke pellets produced with several types of binder and Illinois char in the coke-preparation PDU indicates that untreated hydrogenation-derived binder yields weaker coke than do binders containing high concentrations of carbonization-derived heavy oil. However, bench studies show that the quality of hydrogenation heavy oil is significantly improved by airblowing for two hours at 300°C followed by heat treating for four hours at 380°C. Formcoke specimens prepared with the treated binder had an average crushing strength of 10,825 psi, compared with 8375 psi for specimens made with untreated binder.

56327 **Method of restricting the formation of dust when feeding coal into coke ovens.** Beck, K.G.; Rohde, W.; Habermehl, D.; Siebert, W. (to Bergwerksverband GmbH). US Patent 4,055,471. 25 Oct 1977. Priority date 9 Jan 1975, German, Federal Republic of (F.R. Germany). 8p.

A method is disclosed for inhibiting dust formation while feeding coal into a coking chamber, comprising preheating coal and subsequently contacting the coal with an aqueous solution of 30 to 70 percent by weight of waste sulfite liquor in amounts of about 0.5 to 1.0 parts by weight of said solution per 1000 parts by weight of said coal.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 56362, 56376, 56377, 56452, 56943

56328 **Fuel separation process.** Stambaugh, E.P.; Chauhan, S.P. (to Battelle Development Corp.). US Patent 4,095,955. 20 Jun 1978. Filed date 5 May 1976. 10p.

Fine particles of a solid carbonaceous fuel of the coal or coke type are treated to reduce their content of undesired constituents at least including sulfur or ash or both. The treatment comprises forming a mixture of the fuel particles with a liquid aqueous leaching solution, containing one or more cations selected from Groups IA and IIA of the periodic table, which is effective to dissolve the undesired constituents. The mixture is exposed to temperatures in the range of about 150 to 375°C under a pressure of at least the autogeneous steam pressure until the solution has dissolved the undesired constituents of the fuel to such an extent that the undesired constituent content of the fuel particles has been reduced to less than a desired limit. The major portion of the solution is then separated from the fuel particles under temperature and pressure conditions and within a time period such that the amount of the undesired constituents dissolved in the solution is not substantially reduced by precipitation, adsorption on the fuel particles, or chemical recombination therewith. The separation is typically carried out by filtering the solution to remove the solid fuel particles. The temperature of the mixture is typically maintained in the range of about 100 to 375°C during the separation step, desirably at about the same temperature and pressure as those used during the dissolving step.

56329 **Extracting sulfur and ash.** Stambaugh, E.P. (to Battelle Memorial Inst.). US Patent 4,055,400. 25 Oct 1977. Filed date 7 Apr 1975. 10p.

A method is disclosed for extracting a substantial proportion of the pyritic, organic, and sulfate sulfur compounds and ash present in a solid carbonaceous fuel of the coal or coke type comprising mixing the fuel with an aqueous alkaline solution containing a sodium, calcium, or ammonium carbonate, hydroxide, sulfide, or hydrosulfide, or a plurality thereof, heating the resulting mixture to at least about 125°C at a pressure of at least about 25 psig to leach out the sulfur compounds and ash, separating the easily removable leached out materials from the remainder of the fuel, and washing said remainder of the fuel. The concentration of alkali in the solution typically is about 1 to 35 percent by weight, and the mixture typically is heated for at least about 5 minutes at about 350°C, about 1 hour at 300°C, about 2 hours at 250°C, about 4 hours at 200°C, about 10 hours at about 125°C, or for at least a time approximately proportionately between the foregoing times at an intermediate temperature. The pressure may be provided at least in part by oxygen, hydrogen, nitrogen, oxygen plus nitrogen or hydrogen plus nitrogen.

56330 **Process for the desulfurization of carbonaceous fuels with aqueous caustic and oxygen.** Longanbach, J.R. (to Occidental Petroleum Corp.). US Patent 4,054,420. 18 Oct 1977. Filed date 11 Apr 1974. 4p.

This invention covers a process for reducing the sulfur content of carbonaceous fuels by treatment at elevated temperatures in a system comprised of aqueous caustic and oxygen. It has been discovered that greatly improved results in desulfurizing carbonaceous fuels are achieved with an aqueous caustic solution if an oxygen containing gas is introduced into the solution. It is not fully understood why the presence of oxygen should improve the desulfurizing effect of the aqueous solution or what chemical reactions are occurring during said desulfurization. It has been observed, however, that virtually all of the sulfur that is removed from the fuel by the instant invention is in the form of alkali sulfates and thus the invention also provides a means for the manufacture of such sulfates.

HYDROGENATION

REFER ALSO TO CITATION(S) 56363

GASIFICATION

REFER ALSO TO CITATION(S) 56375, 56901

56331 (ANL-FE—49622-15) **Instrumentation and Process Control for Fossil Demonstration Plants. Quarterly technical progress report, October—December 1977.** LeSage, L.G.; O'Fallon, N.M. (Argonne National Lab., IL (USA)). Jan 1978. Contract W-31-109-ENG-38. 63p. Dep. NTIS, PC A04/MF A01.

Progress on ANL 189a 49622, Instrumentation and Process Control for Fossil Demonstration Plants (FDP) is reported. Work has been performed on updating the study of the state-of-the-art of instrumentation for FDP, development of mass-flow and other on-line instruments for FDP, process control analysis for FDP, and organization of a symposium on instrumentation and control for FDP. A Solids/Gas Flow Test Facility (S/GFTF) under construction and nearly completed for instrument development, testing, evaluation, and calibration is described. Design considerations of a high temperature (800°F) S/GFTF are discussed. Development work for several mass-flow and other on-line instruments is described: acoustic flowmeter, capacitive density flowmeter, neutron activation flowmeter and composition analysis system, gamma ray correlation flowmeter, optical flowmeter, and capacitive liquid interface level meter.

56332 (CONF-780611—8) **Peat gasification: an experimental study.** Punwani, D.V.; Nandi, S.P.; Gavin, L.W.; Johnson, J.L. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract EX-76-C-01-2469. 34p. Dep. NTIS, PC A03/MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

The United States has the second largest peat reserves in the world. The total energy contained in the peat resources (about 120 billion tons) is equivalent to 1440 quads or 240 billion barrels of oil. These enormous energy reserves in peat are greater than those estimated to be available from the reserves of uranium, oil shale, lignite, anthracite or natural gas and petroleum combined, and are exceeded only by the energy reserves in subbituminous and bituminous coal. This paper presents the results of peat gasification tests conducted in laboratory-scale equipment. The results show that, compared to lignite, peat is several times more reactive and makes four times as much light hydrocarbon gases (C_1 and C_2) during initial short-residence-time (5 seconds) hydrogasification. The results also show that compared to coal (at temperatures above 1440°F), hydrogen pressures above 4 atmospheres are relatively less essential for increasing light hydrocarbon gas yields. On an overall basis, the results show that peat is an exceptionally good raw material for SNG production. Based on the experimental results, a conceptual commercial reactor configuration has been selected. It incorporates a dilute-phase, cocurrent, short-residence-time, hydrogasification stage followed by fluidized-bed char gasification with steam and oxygen. Tests in process development units are in progress.

56333 (CONF-780611—9) **Instrumentation for advanced processes for coal utilization.** Managan, W.W.; Raptis, A.C.; O'Fallon, N.M.; Herzenberg, C.L. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 23p. Dep. NTIS, MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

Portions of document are illegible.

Process control instrumentation for large-scale coal gasification, liquefaction, and fluidized-bed combustion systems is being developed at Argonne National Laboratory. Initial focus is on instrumentation to measure mass-flow rates and provide continuous in-stream analysis of solids in solids/fluids streams. These instruments and others are described.

56334 (COO—2904-7) **Chemical and physical stability of refractories for use in coal gasification. Quarterly progress report, November 1, 1977—January 31, 1978.** Rahman, S.F.; Day, D.E. (Missouri Univ., Rolla (USA)). 10 Feb 1978. Contract EY-76-S-02-2904. 53p. Dep. NTIS, PC A04/MF A01.

General conclusions are based on the results obtained to date in the three CO/H_2O and 60 day exposure tests: (1) Large weight losses were observed for refractory samples immersed in water in the $CO/H_2O = 3$ test compared to $CO/H_2O = 0.1$ or 1 tests and, in general, increased with increasing CO/H_2O ratio. This weight loss is most likely due to the dissolution of CaO from the refractories. Chemical analysis is in progress. (2) The weight changes in the unsaturated (1000°F) and saturated (532, 466, and 400°F) vapors were basically the same in the three CO/H_2O tests. (3) With a few exceptions high and intermediate alumina refractories generally had the lowest porosity when exposed to the saturated atmosphere (vapor or liquid) at $CO/H_2O = 0.1$ and the highest when immersed in water at $CO/H_2O = 3.0$. (4) Porosities of high and intermediate alumina refractories in unsaturated atmospheres and insulating castables in saturated and unsaturated atmospheres generally remained nearly constant for CO/H_2O ratios of 0.1 to 3. (5) The effect of saturation on the flexural strength of high and intermediate alumina was significant in all three CO/H_2O tests and, in general, the flexural strength increased by a factor of 2 compared with the unexposed samples or samples exposed to unsaturated conditions. The effect of saturation on the insulating castables was slightly beneficial at $CO/H_2O = 1$ and 3 where the flexural strength generally increased. Changes in weight, dimension, density-porosity, and MOR of refractory samples after a 60 day exposure in the ERDA atmosphere were basically the same as observed after 30 days in similar exposure conditions.

56335 (DOE/ET—0024/1) **Coal gasification. Quarterly report, January—March 1977.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion; Cameron Engineers, Inc., Denver, CO (USA)). Dec 1977. Contract EX-76-C-01-2297. 71p. Dep. NTIS, PC A04/MF A01.

High-Btu natural gas has a heating value of 950 to 1,000 Btu per standard cubic foot, is composed essentially of methane, and contains virtually no sulfur, carbon monoxide, or free hydrogen. The conversion of coal to high-Btu gas requires a chemical and physical transformation of solid coal. However, because coal has widely differing chemical and physical properties, depending on where it is mined, it is difficult to process. Therefore, to develop the most suitable techniques for gasifying coal, ERDA, together with the American Gas Association is sponsoring the development of several advanced conversion processes. Although the basic coal-gasification chemical reactions are the same for each process, the processes under development have unique characteristics. A number of the processes for converting coal to high Btu and to low Btu gas have reached the pilot plant stage. The responsibility for designing, constructing and operating each of these pilot plants is defined and progress on each during the quarter is described briefly. The accumulation of data for a coal gasification manual and the development of mathematical models of coal gasification processes are reported briefly. (LTN)

56336 (FE—1514-82) **Advanced coal gasification system for electric power generation. First quarterly progress report, FY-1978, 1 October—31 December 1977.** Salvador, L.A.; Kearns, D.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Coal Conversion Dept.). 7 Apr 1978. Contract EX-76-C-01-1514. 84p. Dep. NTIS, PC A05/MF A01.

Test TP-013-3 was conducted to explore the feasibility of feeding coal directly to the gasifier without the benefit of pretreatment, either by pyrolysis or oxidation. Most of the major design and procurement tasks relative to PDU modifications were completed. Laboratory support work and the development and testing of a mathematical model of gasifier performance are described.

56337 (FE—1548-14) **Experimental and process design study of a high rate gasification process. Quarterly technical report No. 13, April—June 1977.** Coates, R.L. (Eyring Research Inst., Provo, UT (USA)). Aug 1977. Contract EX-76-C-01-1548. 77p. Dep. NTIS, PC A05/MF A01.

A total of 193 test runs have been made with the experimental gasifier to date at pressures ranging from five to 10 atmospheres. Extensive equipment modifications have been made to overcome problems with non-uniform coal feeding, feed injector plugging, refractory overheating, heat recovery section plugging and scrubber discharge plugging. Over twenty different feed injector and reaction chamber configurations have been tested. The data obtained to date have been analyzed and correlations were made of the fuel gas yield with oxygen/carbon feed ratio and combustion stage space time. The yield is very sensitive to variations in the feed ratio, but variations in the space time between 50 to 290 milliseconds result in no significant effect on the yield. Correlations have also been made indicating the approach to equilibrium of the steam/carbon, the CO_2-carbon reactions were rate limiting, the data obtained to date were then analyzed to obtain approximate values of the surface reaction rate coefficients for these reactions. The magnitudes of these coefficients were found to be consistent with literature values. A preliminary design study was made of a commercial scale gasifier having a throughput capacity of 25 tons per hour. Detailed cost estimates were prepared for the equipment required for coal preparation, gasification, gas cooling and ash handling.

56338 (FE—1794-32) **Development of coal screw feeder: Phase-II report.** Mistry, D.K. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). Feb 1978. Contract EX-76-C-01-1794. 197p. Dep. NTIS, PC A09/MF A01.

The objective of this DOE sponsored program is to develop a dry coal screw feeder for feeding coal into coal gasification reactors operating at pressures up to 1500 psig. The program consists of three phases: establish system requirements and generate new concepts, laboratory development of screw feeder, and pilot plant screw feeder. This report covers the work performed during Phase II, the laboratory development of a 1.5" and a 5.5" diameter screw feeder. A description of both feeders and their associated test systems is

given. All of the results and findings obtained during the development of both screw feeders are presented.

56339 (FE—1794-37) **Coal feeder development program. Monthly technical progress report, April 21, 1978—May 20, 1978.** Mistry, D.K. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). May 1978. Contract EX-76-C-01-1794. 30p. Dep. NTIS, PC A03/MF A01.

Preliminary testing of the coal screw feeder in the injection mode (without external heat) suggested the need for design modifications in the test system. These modifications were incorporated and testing will resume during next week. An investigation was initiated to identify additives which can be used as a coal plug binder and/or screw surface lubricant. The feasibility of spray feeding of fully plasticized coal was established against gas back pressure up to 1100 psig in injection mode of operation. Several steady state test operations against gas back pressures of 50, 300 and 800 psig were obtained. The single acting piston feeder design was simplified with an external mechanical interlock. The piston seals and feeder test system design progressed satisfactorily. The hydraulic power unit for the 3-inch experimental model was received and shakedown testing was completed. The design and detailing of the 9-inch experimental model is 80% complete.

56340 (FE—2210-25) **Study of heat transfer through refractory lined gasifier vessel walls. Quarterly progress report, September 1977—December 1977.** Schorr, J.R. (Battelle Columbus Labs., OH (USA)). Feb 1978. Contract EX-76-C-01-2210. 21p. Dep. NTIS, PC A02/MF A01.

The design of refractory linings for coal gasification vessels is important to the reliable and cost-effective operation of the process. The objective of this program is to develop an empirically derived computer model suitable for use by the vessel designer to determine heat flow through multicomponent, refractory-lined gasifier vessel walls, so that the effects of parameters such as lining thickness, density, refractory composition, physical form, metal anchor spacing and configuration, and gas pressure and composition can be predicted. The program includes the design, construction, and operation of test apparatus for evaluating these parameters which influence heat flow through refractory lining materials.

56341 (FE—2229-8) **Surface structure and mechanisms of gasification catalyst deactivation. Annual report, February 1977—January 1978.** Reucroft, P.J.; Bradley, E.B.; De Angelis, R.J.; Sargent, G.A. (Kentucky Univ., Lexington (USA)). Apr 1978. Contract EX-76-C-01-2229. 84p. Dep. NTIS, PC A05/MF A01.

A series of standard samples ($Ni(Oh)_2$, NiS, $NiSO_4$, nickel silicate and nickel aluminate) have been studied by ESCA. NiS and $NiSO_4$, which may be present in sulfided catalysts, are easily recognized. A series of alumina supported nickel catalysts with metal loading ranging from 10 to 40% by weight were characterized as having the nickel present in the form of an aluminate. Etching studies of the C150 series of catalysts reveals that it is possible under certain conditions to reduce nickel on a silica support, but that it is rarely possible to get more than 10% reduction for nickel on an alumina support. C150 catalysts, which had been treated with synthesis gas and with a sulfiding gas mixture, were examined by ESCA. A series of $MgSiO_3$ supported catalysts were studied by ESCA. $MgSiO_3$ appears to be a more inert support material. Sulfiding a Ni/$MgSiO_3$ sample again led primarily to the formation of NiS. X-ray diffraction studies to determine the particle size distribution in reduced and passivated catalysts have been continued. The results obtained on reduced and sintered catalyst C150-1-01 are summarized. Auger electron spectroscopy has been employed to investigate atom distributions in both fresh and used catalyst pellets. The results suggest that a contaminated layer of about 400A depth was present on the surface. The NiO particles were more susceptible to the contamination than the Al_2O_3 particles. Auger electron spectroscopy has also been employed in an investigation of the interaction of CO with the co-precipitated catalysts. The presence of S on the surface of the catalyst was found to considerably reduce the adsorption of CO. The adsorption chamber used during Raman spectral acquisition of adsorbed gases on Ni surfaces is described. Experimental procedure for the gas adsorption onto Ni(111) is presented and the resulting Raman spectra interpreted.

56342 (FE—2240-87) **Quarterly technical progress report for the period, April—June 1978.** Detman, R. (Braun (C.F.) and Co., Alhambra, CA (USA)). Jul 1978. Contract EX-76-C-01-2240. 13p. Dep. NTIS, PC A02/MF A01.

The contract for monitoring coal gasification pilot plants performance was further extended to the end of August 1978 to provide additional time for selection of a new evaluation contractor. Braun will continue with general program activities, to monitor pilot plant operations, evaluate run performance, monitor the MPC materials program, and complete the remaining technical reports currently under review. All engineering work has been completed and draft reports submitted for review and comment to DOE-GRI and the GRI Project Advisors. Some six of the nine remaining reports were reviewed at a joint meeting on June 21 and recommended for publication. These reports will be submitted to DOE for final approval to publish. The three remaining reports requiring some revision will be resubmitted in draft form for review during the next quarter. Following release to publish the remaining reports, a final report will be submitted for approval. Progress at the various gasification pilot plants is reported briefly.

56343 (FE—2433-20) **Environmental assessment of the HYGAS Process. Project No. 9025 quarterly progress report No. 5, July 1—September 30, 1977.** (Institute of Gas Technology, Chicago, IL (USA)). Mar 1978. Contract EX-76-C-01-2433. 24p. Dep. NTIS, PC A02/MF A01.

A revised and enlarged test plan for the environmental assessment program of the HYGAS (registered trademark) process is under development. The initial environmental assessment was carried out with Rosebud subbituminous coal in Tests 55 through 58. With Test 59, pilot plant studies were started with Illinois No. 6 bituminous coal from the Peabody No. 10 mine. This is an agglomerating coal requiring pretreatment, and therefore all process units are used. Tests 61 through 65 were analyzed. Pollutant production rates from effluent waters during Tests 59 through 64 are presented here. Production rates during Test 64 were, in general, higher than other tests, possibly due to the higher range of char gasification obtained. The reactions of sulfur species across the pretreater and gasifier and the gasification of total sulfur as a function of species and reaction stage are reported for Tests 61 through 63. The major sulfur loss during pretreatment occurred from the organic and pyritic forms. The sulfur chromatograph was used for initial scans of gas samples during Test 65. These scans showed the ratio of hydrogen sulfide to carbonyl sulfide to be quite large (possibly greater than 100); the presence of methyl mercaptan, dimethyl sulfide, ethyl mercaptan, diethyl sulfide, dimethyl disulfide, and carbon disulfide was detected. Some heavier sulfur compounds were detected but not identified. A RAC-3 gas sampling system was purchased to analyze for SO_2, H_2S, and NH_3 in selected gas streams. Laboratory experiments to determine the effects of a shift catalyst on pollutant levels in the gas stream were concluded with three additional experiments. A gas sampling line for gasifier product gas prior to quench was modified to service both the sulfur chromatograph and a gas sampling train designed and built by CMU. The sampling train was installed for operation during Test 64 for shakedown and testing.

56344 (FE—2434-20) **Pipeline gas from coal-hydrogenation IGT Hydrogasification Process). Project 9000 quarterly report No. 5, July 1—September 30, 1977.** (Institute of Gas Technology, Chicago, IL (USA)). Feb 1978. Contract EF-77-C-01-2434. 94p. Dep. NTIS, PC A05/MF A01.

Details are reported of a post-run inspection and cleanup conducted after Test 63. The annual plant turnaround was conducted. This turnaround period is required for routine maintenance, repairs, and installation of new equipment, all of which are necessary for successful plant operation. As such, the annual plant turnaround is an integral part of advancing pilot plant studies to provide data for a commercial/demonstration plant design. Current tests are aimed at acquiring data for a commercial/demonstration plant by conducting an extended run (No. 64) with Peabody No. 10 Mine bituminous coal at high carbon conversions. Eight and one-half days of self-sustained operation at coal conversions ranging from 72% to 97% occurred during Test 64. This was a major step toward achieving the immediate contract objective. An electrical power failure, caused by an equipment malfunction in Commonwealth Edison's main power supply to the plant, forced the termination of test No. 65 after only 9 tons of coal had been processed. A coal-flow model was designed and constructed to simulate the second-stage gasifier and steam-oxygen gasifier. This model was used to investigate how the fluidized bed is established in the steam-oxygen gasifier and the stability of the bed to process upsets. Results of tests with this model are presented. Engineering assistance was provided to ERDA-Major Facilities Program Management (MFPM) and Procon, Inc., in the design of a commercial/demonstration plant based on the HYGAS (registered trademark) Process. This report contains the computer-generated material balance data presented to them. A detailed comparison of the actual HYGAS reactor results vs. those predicted by a computer model simulation is presented.

56345 (FE—2518-12) **Hydrogasifier development for the Hydrane process. Third quarter report, September—November 1977.** Combs, L.P.; Greene, M.I. (Rocketdyne, Canoga Park, CA (USA)). Mar 1978. Contract EX-77-C-01-2518. 71p. Dep. NTIS, PC A04/MF A01.

This report describes work performed on a program to develop a single-stage, short-residence-time reactor for flash hydrogasification of coal. The program comprises both experimental and analytical tasks. Experiments involve two different hydrogasifier reactor systems. The first is a bench-scale apparatus with coal feed rates of 2 to 4 lb/hr. Results are reported for a subbituminous coal reacted

with hydrogen at pressures up to 1500 psig, reactor temperatures ranging from 1475 to 1728°F, and residence times ranging from 300 to 3500 msec. Overall carbon conversions varied between 18 and 55 percent and were quite comparable with conversion of lignite observed previously. The second reactor has a nominal coal feed rate of 1/4 ton/hr. Results from tests with subbituminous coal compared well with those from the bench-scale reactor. Test conditions extended to higher reactor temperatures but not to as high residence times; maximum overall subbituminous carbon conversion achieved was 47 percent. A bituminous coal and a peat were also run in the 1/4-ton/hr reactor and were found to yield progressively higher carbon conversions for comparable test conditions. Analytical effort consists of two parts. One is a computerized numerical model of pulverized coal flow and reaction in an entrained-flow reactor. The other is a computer model of a complete commercial coal gasification plant utilizing a flash hydrogasifier. The model comprises material and energy balances for all plant subsystems, and factored economic correlations for capital requirements and operating costs. Reactor operation will be optimized to minimize predicted cost of SNG. Progress in programming both models is described briefly.

56346 (FE—2542-1) **Phase I: the pipeline gas demonstration plant. Quarterly technical progress report, 2 July—30 September 1977.** Watson, W.B.; Sweany, G.A. (Continental Oil Co., Stamford, CT (USA)). [nd]. Contract EF-77-C-01-2542. 104p. Dep. NTIS, PC A06/MF A01.

In May, 1977, U.S. ERDA and Continental Oil Co. signed a contract for approximately $370,000,000 for the design, construction and operation of a Pipeline Gas Demonstration Plant. The 22-month first phase, Development and Engineering, is fully funded by ERDA and budgeted at about $25,000,000. The remaining six-plus years will be funded on a 50/50 industry/government basis. The project involves the design of a Commercial Plant and a Demonstration Plant. All processes except the gasification process have been demonstrated in commercial ventures elsewhere. The gasification process is the British Gas/Lurgi Slagging Gasifier which was developed in a privately sponsored program at Westfield Development Center in 1975. The Commercial Plant design, based on a plant site in Montgomery Co., Illinois, will produce approximately 250 MMSCFD of pipeline quality gas from 1,050,000 LB/HR. (MAF) Illinois No. 6 coal. The Demonstration Plant is a grass-roots facility located in Noble County, Ohio. The plant will process 202,500 LB/HR. of high-sulfur coal (MAF basis) to produce over 50 MMSCFD of pipeline quality gas with a higher heating value exceeding 955 Btu/SCF. A Technical Support Program utilizing a prototype reactor at the Westfield Development Center, Scotland, is designed to yield information confirming the assumptions used in the Demonstration Plant design. Additionally, use of special materials of construction for critical gasifier components will be demonstrated. Early test runs indicate these objectives can be met.

56347 (MERC/SP—78/3) **Design criteria for lock hopper valve development.** (TRW Energy Systems Group, Morgantown, WV (USA)). 15 May 1978. Contract EY-77-C-21-8085. 37p. Dep. NTIS, PC A03/MF A01.

This document has been prepared to define the design criteria to be applied to the development of valves for solids handling lock hopper use in coal conversion processes. Criteria are supplied for four types of lock hopper valves based on analysis of those gasification processes deemed most promising for demonstration plants and a desire for valve life comparable with other coal conversion plant equipment.

56348 (PB—276608) **Analyses of grab samples from fixed-bed coal gasification processes. Final report January—July 1977.** Bombaugh, K.J. (Radian Corp., Austin, TX (USA)). Dec 1977. Contract EPA-68-02-2147. 85p. NTIS PC A05/MF A01.

The report gives results of an analytical screening of selected effluent samples from operating coal gasification units. The work was done to aid in planning for future more comprehensive environmental test programs which will be conducted at gasification units both in the U.S. and abroad. A secondary objective was to evaluate EPA's phased approach to environmental testing of coal gasification units. Grab samples--including tar, process condensate, gasifier ash, and cyclone dust--from five different commercial-scale gasifiers and one pilot-scale gasifier were obtained for the study. All were single-stage, fixed-bed, atmospheric-pressure, air-blown units; however, the materials consumed by the gasifiers included both bituminous and anthracite coals. The analyses were intended as a preliminary identification of the classes of compounds in each sample which warrant further attention. The study resulted in many significant conclusions relating to: the classes and concentrations of components in specific samples; the effects of feedstock and process operating condition changes on the levels of key components detected in the samples; and modifications/additions to suggested EPA procedures which would help ensure that the maximum amount of useful environmental information is obtained from future programs.

56349 (SAND—77-0638C) **Analysis of conduction responses during an underground coal gasification experiment.** Hommert, P.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780805—4). Dep. NTIS, PC A02/MF A01.

From 6. heat transfer conference; Toronto, Canada (7 Aug 1978).

The Laramie Energy Research Center (LERC) conducted an underground coal gasification experiment in a 9-m thick subbituminous coal seam near Hanna, Wyoming. Sandia Laboratories designed and fielded an extensive instrumentation array which included approximately eight thermocouples within the seam in each of 15 diagnostic wells. The instrumentation provided thermal data related to the process during both reverse combustion linkage and forward gasification. Portions of these data suitable for analysis by inverse heat conduction techniques included (1) the responses from the approximately cylindrical reverse combustion linkage path and (2) the responses at thermocouples outside the gasified zone due to conduction from the final boundary. Because of the effects of property variations and water vaporization on the conduction response, an exact analytical solution could not be used. Instead, the approach was to adjust parameters of the constant property analytical solutions to fit numerical calculations that included property variations and water vaporization. Sensitivity studies performed to estimate the accuracy of solutions obtained indicated that parameters relating to size and distance should be identifiable within +- 0.25 m; however, accurate estimates of temperature could not be obtained. Results allowed the position of the reverse combustion linkage path to be mapped, and estimates of its size (approximately 1 m in diameter) and average temperature (750 K—1000 K) to be obtained. With respect to forward gasification, the analysis yielded estimates of the final boundaries established by the burn and characterizations of how the front approached its final position.

56350 (SAND—78-1317C) **Analysis of the electrical potential data for the Hanna IV underground coal gasification test.** Bartel, L.C. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 11p. (CONF-780723—3). Dep. NTIS, PC A02/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

The direct excitation electrical potential (DEEP) technique is used to delineate the process on the Hanna IV underground coal gasification experiment being conducted by the Laramie Energy Research Center. The DEEP technique is essentially a dynamic "mise-a-la-masse" method where the process well in contact with the hot conducting reaction zone forms one current electrode. The potentials produced by the changing current electrode are measured by a fixed surface array. A ridge regression data inversion algorithm is being developed to use the potential data to fit model parameters which delineate the process. A preliminary version of the algorithm has been applied to data from selected days of the Hanna IV test. The reaction zone boundaries delineated by the algorithm are in very good agreement with boundaries determined from the thermal data. The use of electrical techniques to remotely monitor the underground coal gasification process is demonstrated.

56351 (SAND—78-8253) **Sampling from high temperature particle laden flows.** Branch, M.C. (Sandia Labs., Livermore, CA (USA)). Jul 1978. Contract EY-76-C-04-0789. 38p. Dep. NTIS, PC A03/MF A01.

The development of coal conversion technology and technology for use of heavy hydrocarbon fuels is limited by the inability to measure properties of the reacting particle-laden flows encountered in these systems. Optical techniques are promising for nonperturbing measurements of temperature, velocity and some species compositions. Physical probe sampling must be used for measurements of many stable species and most properties of the particulate phase. This review presents problems associated with probe sampling in high temperature flows with particular emphasis on characterization of the particulate properties of the flow. Sampling errors and probe design alternatives are considered.

56352 (TIS—5146) **Low-Btu gasification of coal: a C-E status report.** Patterson, R.C. (Combustion Engineering, Inc., Windsor, CT (USA)). [nd]. Contract EX-76-C-01-1545. 12p. (CONF-770831—2). Dep. NTIS, PC A02/MF A01.

From 4. international conference on coal gasification, liquefaction and conversion to electricity; Pittsburgh, PA, USA (4 Aug 1977).

Since the publication of References 1 and 2, the Combustion Engineering Coal Gasification Program has progressed through completion of research and development related to process and equipment needs, detail design of a 5-ton-per-hour process development unit (PDU), and equipment procurement and construction of the PDU at C-E's Windsor, Connecticut site. Initial operation of the PDU is scheduled for August 1977. The purposes of this paper are to: Briefly review the objectives and scope of the program; summarize highlights of the program's R and D work to date; describe the PDU and its construction status; and outline the PDU test program.

56353 (UCRL—81267) **Geotechnical instrumentation applied to in situ coal gasification induced subsidence.** Ganow, H.C.; Greenlaw, R.C.; Langland, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jun 1978. Contract W-7405-ENG-48. 15p. (CONF-780723—1). Dep. NTIS, PC A02/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

A comprehensive geotechnical instrumentation program has been conducted in conjunction with the second Lawrence Livermore Laboratory in situ coal gasification experiment. Instrumentation systems selected for use include multiple position borehole extensometers, borehole deflectometers, piezometers, electrical shear strips, and surface bench marks. The instruments have been arrayed about the experimental site based on the writers' experience and intuition, the results of a preliminary finite element method model calculation, and detailed knowledge of the site geology. The resulting data will be used to assess the potential environmental impact of subsidence caused by in situ coal gasification and to provide a factual data base for comparison with computer results. The philosophy of instrument application and their installation are discussed in the context of the expected surface and subsurface deformations, and the Hoe Creek Site II geology. Preliminary data from the extensometers and shear strips, and piezometers document progressively higher roof collapse and its associated effect on subsurface fluid pressures, respectively. Although bubbler tests on gas-sample tubes suggest that roof collapse has occurred to 60 ft. (18.3 m) above the top of the Felix No. 2 Coal, surface subsidence has been minimal. It is likely that the Felix No. 1 Coal participated in the gasification process to a limited extent.

56354 (UCRL—81271) **Ground-water and subsidence investigations of the LLL in situ coal gasification experiments.** Mead, S.W.; Ganow, H.C.; Wang, F.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract W-7405-ENG-48. 9p. (CONF-780723—4). Dep. NTIS, PC A02/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

Ground-water sampling and subsidence measurements have been carried out at the sites of two in situ coal gasification experiments conducted in northeastern Wyoming by the Lawrence Livermore Laboratory. Changes in ground-water quality and the possible effects of subsidence and ground movement induced by the gasification cavity represent important environmental concerns associated with the in situ coal gasification process. Our ground-water quality measurements near the site of the first experiment (Hoe Creek I) show a continuing decrease, after more than a year, in the concentration of important contaminants such as phenolic materials. Laboratory measurements have provided detailed information concerning phenol adsorption by coal. Long-term effects due to ground-water flow, and the detailed behavior of other contaminants remain to be investigated. Data from subsurface geotechnical instruments installed at the second gasification experiment (Hoe Creek II), as well as measurements of ground-water levels indicate that roof collapse has connected the gasification cavity with overlying aquifers. The implications of this interconnection for the dispersal of underground contaminants are being investigated.

56355 **Coal gasification apparatus.** Kuenstle, K.; Koch, C.; Reiter, K. (to Kraftwerk Union AG). US Patent 4,095,959. 20 Jun 1978. Priority date 6 Mar 1976, German, Federal Republic of (F.R. Germany). 8p.

Coal gasification apparatus is described having a hydrogenation gasifier chamber for gasifying a portion of coal charge and a steam gasifier vessel for gasifying unconverted coal from the hydrogenation chamber with the chamber disposed above the vessel and a pressure lock interposed between the outlet of the chamber and the inlet of the vessel to permit unconverted coal to flow into the vessel and prevent gas generated therein from passing into the chamber. An oxygen inlet is provided at the lower end of the vessel for residual-oxidation of remaining coal. A heat exchanger is provided for heat exchange between hot gas leaving vessel and incoming steam. The chamber may be preceded by a steam-heated heating tank for preheating the coal under pressure and then suddenly decompressing the coal. 6 claims, 3 figures.

56356 **Method of underground gasification of a coal bed.** Antonova, R.I.; Kreinin, E.V. US Patent 4,083,402. 11 Apr 1978. Priority date 2 Apr 1975, Union of Soviet Socialist Republics (USSR). 6p.

A method for controlling the process of underground gasification of a coal bed, with due provisions for the natural geological and mining conditions is disclosed. The rate of gassing-out the coal bed required for good efficiency of the process depends on the water inflow, seam thickness and properties of the coal and can be calculated from a formula given.

56357 **R and D status report. Fossil Fuel and Advanced Systems Division.** Balzhiser, R.E. *EPRI J.;* **2**: No. 9, 33-35(Nov 1977).

Work on coal gasification-combined cycle power generation systems is described.

56358 **Ammonia from coal.** Netzer, D.; Moe, J. *Chem. Eng. (N.Y.);* **84**: No. 23, 129-132(29 Oct 1977).

This paper describes the Texaco coal gasification process which yields a gas suitable for conversion to ammonia. The advantages of this process are that any type of coal can be gasified without the production of troublesome byproducts, and that coal delivered as a slurry can be gasified directly. An analysis of the economics of the process is included.

56359 **Belgium: first in-situ gasification test.** *World Coal;* **3**: No. 10, 14(Oct 1977).

The Belgium Economics Ministry has announced that the first field test in connection with Belgo-German R and D on underground coal gasification is being planned for end 1977/beginning 1978. Ministry geologists have proposed the site of Thulin near Mons, an area of four square kilometres in a sparsely populated region. Coal reserves are estimated at 80,000,000 tons. In view of the fact that the total cost of these tests amounts to 430,000,000 Belgian francs, the Belgian Government would welcome a broadening of the international cooperation involved.

LIQUEFACTION

REFER ALSO TO CITATION(S) 56331, 56333, 56351, 56375

56360 (DOE/ET—0026/2) **Coal liquefaction. Quarterly report, April—June 1977.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion; Cameron Engineers, Inc., Denver, CO (USA)). Jan 1978. Contract EX-76-C-01-2297. 64p. Dep. NTIS, PC A04/MF A01.

The United States has more energy available in coal than in petroleum, natural gas, oil shale, and tar sands combined. Nationwide energy shortages, together with the availability of abundant coal reserves, make commercial production of synthetic fuels from coal vital to the Nation's total supply of clean energy. In response to this need, the Office of Fossil Energy of the Energy Research and Development Administration (ERDA) is conducting a research and development program to provide technology that will permit rapid commercialization of processes for converting coal to synthetic liquid and gaseous fuels and for improved direct combustion of coal. These fuels must be storable and suitable for power generation, transportation, and residential and industrial uses. ERDA's program for the conversion of coal to liquid fuels was begun by two of ERDA's predecessor agencies: Office of Coal Research (OCR) in 1962, and Bureau of Mines, U.S. Department of the Interior, in the 1930's. Current work in coal liquefaction is aimed at improved process configurations for both catalytic and non-catalytic processes to provide more attractive processing economics and lower capital investment. Coal liquefaction can now be achieved under more moderate processing conditions and more rapidly than was the case in the 1930's. The advantage of coal liquefaction is that the entire range of liquid products, including heavy boiler fuel, distillate fuel oil, gasoline, jet fuel, and diesel oil, can be produced from coal by varying the type of process and operating conditions used in the process. Furthermore, coal-derived liquid fuels also have the potential for use as chemical feedstocks. To determine the most efficient means of utilizing coal resources, ERDA is sponsoring the development of several conversion processes that are currently in the pilot plant stage. Nineteen projects under development are described and progress for each in the quarter is detailed briefly. (LTN)

56361 (FE—2044-35) **Partial liquefaction of coal by direct hydrogenation. Quarterly progress report, April—June 1978.** Oberg, C.L. (Rocketdyne, Canoga Park, CA (USA)). Jul 1978. Contract EX-76-C-01-2044. 20p. Dep. NTIS, PC A02/MF A01.

Efforts were directed toward preparation of the high pressure product recovery system, design of a BTX recovery system, further analysis of results from the short duration tests and preparation for a long duration reactor test. The effort for installation of the high-pressure product recovery system is proceeding largely according to schedule, although some slippage may occur on the delivery schedule for some of the equipment items. Design of the BTX recovery system is proceeding with an anticipated completion in early August. Analysis of the test results has further defined the relationship of hydrogen consumption with reactor operating conditions. The ability to calculate with reasonable accuracy the reactor temperature from product and feed compositions, the feed flow rates, and the heats of combustion of the products and reactants has been demonstrated. The relationship of injector mixing characteristics with carbon conversions has been defined from the data. Beyond PDU testing a pilot plant is needed to further develop the flash hydropyrolysis process and allow commercialization. The objective of a pilot plant program would be to demonstrate key and unique aspects of the process, develop process and economic information needed for

commercialization, including the production of sufficiently large quantities of product to allow thorough testing and evaluation.

56362 (FE—2047-7) **Clean solid and liquid fuels from coal. Quarterly progress report, October—December 1977.** Gary, J.H.; Golden, J.O.; Baldwin, R.M.; Bain, R.L.; Dickerhoof, D.W. (Colorado School of Mines, Golden (USA)). 15 Jan 1978. Contract EX-76-C-01-2047. 67p. Dep. NTIS, PC A04/MF A01.

Eight experimental runs were made on the continuous process evaluation unit. The purpose of these runs was to demonstrate system operability and check for approach to steady-state. The stirred tank reactor was used for these runs, and temperature and pressure were varied to initiate a partial factorial examination of the effect of these two variables on conversion. All experimental work on the CO-Steam catalyst evaluation program was completed. Data analysis on the dry filter cake samples is in progress in an attempt to directly determine the amount of unreacted coal remaining after liquefaction. Data analysis on the HDN catalyst screening program was completed and the results are summarized. Ni-Mo catalysts were shown to be superior for HDN of this coal-liquid feedstock. Further work on the reactivity of individual nitrogen compounds was initiated. Work on classification of nitrogen compounds by column chromatography, ligand exchange and gas chromatography continued. Mass spec data on fractions was correlated with data gathered by gas chromatography. Examination of the selectivity for nitrogen removal was initiated for various resins.

56363 (FE—2328-13) **Deuterium tracer method for investigating the chemistry of coal liquefaction. Annual technical progress report, July 1976—June 1977.** Skowronski, R.P.; Ratto, J.J.; Heredy, L.A. (Atomics International Div., Canoga Park, CA (USA)). Feb 1978. Contract EX-76-C-01-2328. 99p. Dep. NTIS, PC A05/MF A01.

A novel deuterium tracer method was established and demonstrated. This method permits the determination of the sites of hydrogen incorporation in the coal structure during hydrogenation. Specifically, the method consists of conducting pairs of hydrogenation experiments, one with protium (the common isotope of hydrogen) and the other with deuterium, under identical experimental conditions. For each pair of experiments, the hydrogenated products are analyzed by proton nuclear magnetic resonance (NMR) spectrometry. All products were also analyzed by carbon-13 NMR spectrometry to obtain insight into the structural characteristics of the carbon skeletons of the hydrogenation products. Aside from the advantage of direct observation of the carbon skeleton, carbon-13 NMR affords the direct observation of carbon-containing functional groups that have no attached protons (e.g., carbonyls). Preliminary experiments were conducted to establish effective operating conditions for the planned hydrogenation experiments. Then, in order to obtain baseline data, the first two pairs of protium/deuterium hydrogenation experiments were conducted with coal and hydrogen. The results of the experiments described, the impact of the results on elucidating the mechanism(s) of coal hydrogenation, and an evaluation of the deuterium tracer method are presented. Also, a comparison between the subtractive technique, using proton NMR spectrometry, and the direct procedure of determining deuterium incorporation using deuteron NMR spectrometry is presented.

56364 (FE—2454-4) **Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, April—June 1977.** Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1977. Contract EX-76-S-01-2454. 133p. Dep. NTIS, PC A07/MF A01.

This report describes work done in a program designed to better understand and improve the Solvent Refined Coal and related liquefaction processes. It was determined that DMF/NH_4SCN was the best solvent system to use when analyzing SRC coal slurries by coulter counter. The agitation rate in SRC type processes was found to have little effect on the rate of particle dissolution, indicating little importance of liquid-solid mass transfer resistance. The variation in coal dissolution rate with solvent/coal ratio was also studied. In pretreatment study, NaOH was found to be effective in removing about 50 percent of the sulfur present in the feed coal. Iron containing compounds still represent the most active mineral catalysts tested to date. Preliminary separation of SRC fractions was made by GPC and the GC-FTIR system was partially completed. A separate abstract was prepared for the appendix.

56365 (FE—2454-4, pp 111-129) **Appendix: Viscosity changes during the preheating period of the Solvent Refined Coal process.** Garg, D.; Guin, J.A.; Tarrer, A.R. 1977.

In Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, April—June 1977.

The Solvent Refined Coal process is currently under consideration for producing low sulfur and low ash boiler fuel from coal. In the SRC process, dried, ground coal is mixed with a coal-derived solvent to make a coal-solvent slurry. The slurry and hydrogen gas are heated in a preheater and then fed to the reactor-dissolver where liquefaction occurs in the presence of hydrogen gas. During the heat-up in the preheater various physico-chemical changes occur in the coal particles. Due to these changes, the viscosity of the coal slurry changes with temperature in the preheater where some coal dissolution begins to occur. Viscosity changes occurring during the heat-up and dissolution period of the coal/solvent slurry were investigated. Such viscosity variation is of importance to the design of preheaters for the SRC process feed slurry. In addition, knowledge of viscosity changes would help to determine the flow regime, pressure drop, and rate of heat transfer in the preheater tubes. Consideration of the results leads one to the hypothesis that if the magnitude of the viscosity peak were plotted as a function of solvent quality (i.e. hydrogen donor ability) there would be a maximum because of two competing effects. For an extremely poor solvent (eg. paraffin oil) the viscosity peak should be negligible because of the absence of coal depolymerization; whereas, if a highly effective solvent (e.g. SRC recycle solvent) were used the peak also would be low but for the opposite reason--that is, very complete coal depolymerization. For solvents with only fair effectiveness (e.g. creosote oil) the viscosity peak is higher than either of the two cases above since only a partial, but significant, depolymerization, of the coal results. This hypothesis is partly verified by experiment.

56366 (FE—2566-12) **Upgrading of coal liquids. Interim report. Hydrotreating and reforming H-Coal process derived naphthas.** Tan, G.; deRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Mar 1978. Contract EF-77-C-01-2566. 50p. Dep. NTIS, PC A03/MF A01.

The objective of this work was to evaluate the applicability of commercial UOP hydrotreating and reforming processes to naphthas derived from the H-Coal process. Three naphthas were studied. One was the primary naphtha generated from the H-Coal syncrude operation. The other two products were from hydrocracking H-Coal gas oil. The primary H-Coal naphtha was rerun in a laboratory column to remove color materials and heavy ends generated during storage. Because of the high contents of nitrogen, sulfur and oxygen, this naphtha was catalytically hydrotreated at moderate conditions to bring the heterocyclics content within the limits acceptable as a Platformer charge stock. The upgraded H-Coal naphtha and the two hydrocracked naphthas were reformed over a commercial Platforming (registered trademark) catalyst in bench scale continuous units. Data were obtained at base pressure, 1.5 x base space velocity, and a range of temperatures for the purpose of constructing yield octane curves. Since all these feeds were highly naphthenic, reforming was successfully carried out at high space velocity and relatively low temperatures with high gasoline yields. In addition to routine analyses, mass spectroscopy (MS) analyses were carried out on the primary H-Coal naphtha, Platformer feeds, and selected reformates.

56367 (IS—4486) **Alloy evaluation for fossil fuel process plants (liquefaction). Quarterly report, 1 April 1978—30 June 1978.** Woods, C.M.; Scott, T.E. (Ames Lab., IA (USA)). 15 Jul 1978. Contract W-7405-ENG-82. 20p. Dep. NTIS, PC A02/MF A01.

Room temperature mechanical properties have been determined for A387-74A-Gr. 22-Cl. 2 steel after exposure to a coal slurry environment at various temperatures and H_2 pressures. Comparison with base property data revealed that no degradation of ambient temperature mechanical properties occurred.

56368 (SAND—78-0837) **Design and operation of a bench-scale coal liquefaction system.** Curlee, R.M.; Hawn, D.C. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 56p. Dep. NTIS, PC A04/MF A01.

This report describes the design, fabrication, and evaluation of a continuous flow, bench-scale, coal liquefaction reactor system. While designed initially to determine engineering kinetics of catalytic hydrogenation, changes in program objectives resulted in a system configured to determine specifics of noncatalytic coal dissolution in liquifiers or preheaters. Design flexibility allowed this change in experimentation and provides for simulation of the preheater conditions of viable coal liquefaction processes. There are descriptions of system capabilities and equipment; discussions of system operation, process conditions, and safety; and of some equipment and materials problems encountered during development and operation. Seven experiments, gathering data specifically concerning preheater reactors, were conducted with good results. Several critical materials and equipment problems were solved, giving the system operational reliability. Experiments to simulate preheater conditions of the H-Coal and SRC processes are continuing.

56369 (SAND—78-1318) **Mineral matter effects and catalyst characterization in coal liquefaction. Second quarterly report. January—March 1978.** Granoff, B.; Thomas, M.G. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MFA01.

Coal liquefaction experiments were carried out in an autoclave facility modified for the rapid (approximately 5 sec) addition of a coal/solvent slurry into a preheated solvent. Sixteen slurry addition experiments have been completed with Illinois No. 6 coal in

tetralin solvent. Six runs were carried at 408°C, 1500 psig and a solvent-to-coal ratio of 4.0, in order to evaluate the effects of residence time (2, 10 and 40 min) and mineral additions (20 wt percent THF-extracted filter cake) on coal liquefaction. Conversion to benzene solubles increased from 24 to 60 percent as residence time increased from 2 to 40 min. An additional 1 to 4 percent increase in conversion occurred when mineral matter was added to the feed slurry. The preasphaltenes increased from 35 to 38 percent, and then decreased to 29 percent as residence time increased from 2 to 40 min. Additional increases in preasphaltenes occurred in the presence of added mineral matter. Hydrogen consumption increased from 0.5 to 1.4 percent as residence time increased. Three fresh and two spent catalysts from the bench reactor at Hydrocarbon Research, Inc. were received. A test matrix has been developed for the quantitative analysis of Co, Ni, Mo, Fe, Ti, Mg, Ca, Zn, Na, Al, Si, and S by electron microprobe analysis, emission spectroscopy and atomic absorption spectroscopy. The electron microprobe will be used for an elemental mapping of approximately 10 percent of the cross sectional area of a catalyst sample. Preliminary data have shown that Ti increased from approximately 2 percent on the surface of a spent catalyst to approximately 7 to 8 percent at 50 to 100 μm depth, and then decreased to approximately 2 percent at 200 μm.

56370 Method for removal of last traces of soluble ash and elements from solvent refined coal. Kindl, F.H. (to Encotech, Inc.). US Patent 4,095,954. 20 Jun 1978. Filed date 14 Jun 1976. 10p.

Solvent refined coal is treated with liquid water at a temperature of about 500 to 550°F in a closed cylindrical vessel under the saturation pressure 665 to 1030 psig of water at that temperature and under gentle agitation to insure low shear liquid-solid contact for about 1/2 to 2 hours. Surprisingly, the soluble ash, generally sodium or potassium salts, is leached out to bring the sodium content down from 50 to 60 parts per million to a value of less than 1 part per million which makes the product very suitable as a feed for direct firing in a gas turbine. In addition the total ash content is reduced from a value of approximately 0.1 percent to a value less than 0.05 percent which means that in addition to reducing the quantity of sodium and potassium, there are other constituents of the ash which also have been removed.

56371 Coal as a source of future transport fuel. Goddard, K. *Chart. Mech. Eng.;* **24**: No. 9, 50-53(Oct 1977).

The possibility of coal liquefaction processes providing transport fuels on a commercial scale is discussed briefly.

56372 Coal conversion: new processes from old. *Chem. Eng. News;* **55**: No. 36, 24-25(5 Sep 1977).

A conceptual design has been completed for the Oil/Gas process which is a coal hydroliquefaction process similar to the Solvent Refined Coal II process but with the reaction conditions altered to produce increased yields of light hydrocarbons for conversion to SNG and liquid products such as liquefied petroleum gas, naphtha, and fuel oils. A new version of the Fischer-Tropsch process is at the same stage of development in which flame-sprayed catalysts are used to give increased thermal efficiency and other advantages.

PYROLYSIS AND CRACKING

56373 Preliminary physiochemical characteristics of pitch obtained from a rapid coal degasification process. Jastrzebski, J.; Tengler, S. *Koks, Smola, Gaz;* **22**: No. 3, 67-70(Mar 1977).

Some physicochemical properties of pitch obtained from the rapid degasification of coal which are relevant to its use as a binder for carbon electrodes are given. The caking power, dilatation, and plastic properties of the benzene-insoluble components which were separated by extraction were determined.

SOLVENT EXTRACTION

56374 Friedel-crafts isopropylation of a bituminous coal under remarkably mild conditions. Schlosberg, R.H.; Gorbaty, M.L.; Aczel, T. (Exxon Research and Engineering Co., Linden, NJ). *J. Am. Chem. Soc.;* **100**: No. 13, 4188-4190(21 Jun 1978).

A bituminous coal, Illinois No. 6, has been treated under Friedel—Crafts alkylation conditions, some as mild as 0 to 5°C and atmospheric pressure. The tools of mass spectroscopy and classical analytical techniques were employed to confirm unequivocally that the coal was alkylated. The alkylated product has both a higher hydrogen content and higher solubility in benzene and pyridine than the untreated coal. This work demonstrates that coal is very much more reactive than is conventionally believed. 5 tables.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 56358

56375 (ORNL/SUB—77/14218/1) **Program to evaluate the potential of the synthesis of chemicals from coal as an ERDA research program.** (Oak Ridge National Lab., TN (USA)). Sep 1977. Contract W-7405-ENG-26. 86p. Dep. NTIS, PC A05/MF A01.

The purpose of this project is to assess the desirability of facilitating the production of chemical feedstocks from coal and oil shale resources, and to provide suggestions for future ERDA research programs based on the results found. Program suggestions are based on a review of factors critical to the use of coal and oil shale for chemical production and the status of current ERDA program efforts. The approach used in the study consists of the following steps: Review of petrochemical feedstock demand and fuel supply demand projections; determination of how coal and oil shale technologies could relate to the processing routes for chemical feedstocks; identification of factors critical to the utilization of coal- and oil shale-drived petrochemical feedstocks; review of ERDA programs potentially related to producing chemicals from coal and oil shale; and suggestions for future ERDA research programs. The suggestions made for ERDA research programs were in the areas of: Catalyst Development; Processing Techniques; Characterization of Liquids; Economics; and Environment, Safety, and Health. Catalyst development is considered to be the most important technological development need for the near term.

56376 Coal purification and electrode formation. Das, S.K. (to Aluminum Co. of America). US Patent 4,083,940. 11 Apr 1978. Filed date 23 Feb 1976. 8p.

A process for purification of coal comprises forming an aqueous leaching solution containing nitric and hydrofluric acid. Impurities are removed by contacting coal having a mesh size not greater than 8 (Tyler Series) with the leaching solution for a period of 15 to 120 minutes at a temperature of 20 to 100°C. During the contacting of coal with leaching solution, a gaseous material such as air can be bubbled therethrough to provide additional mixing action and oxidant material. Thereafter, the solution is removed and the leached coal washed with water.

56377 High purity activity carbon produced by calcining acid leached coal containing residual leaching solution. Das, S.K. (to Aluminum Co. of America). US Patent 4,083,801. 11 Apr 1978. Filed date 20 Dec 1976. 4p.

A process for the production of activated carbon from coal comprises contacting the coal with mineral acids to leach impurities therefrom and removing the leached coal from the mineral acids. Activated carbon is produced by calcining the leached coal at a temperature in the range of 550 to 775°C.

PROPERTIES

REFER ALSO TO CITATION(S) 56344, 56363, 56373, 56403, 56404, 56906, 57256

56378 (IS-M—130) **Coal microstructure and pyrite distribution.** Greer, R.T. (Ames Lab., IA (USA)). 1977. Contract W-7405-ENG-82. 13p. (CONF-770656—29). Dep. NTIS, PC A02/MF A01.

From Annual meeting of the Institute of Nuclear Materials Management; Washington, DC, USA (29 Jun 1977).

Portions of document are illegible.

The microstructure of coal is of interest in understanding coal properties. Microstructural features may affect the selection of coal beneficiation methods for removing impurities. For example, in planning sulfur removal schemes it is useful to understand the proportionment of inorganic sulfur compared with that of organic sulfur. Details of size, shape, orientation, and distribution factors for pyrite, certain pyrite and maceral groupings or fields, or other coal constituents (macerals and other inorganic components) are of importance in supporting rational designs of sulfur removal processes. Recent scanning electron microscope (SEM) investigations help to show the interrelations between macerals and inorganic phases such as pyrite (FeS_2, the primary inorganic source of sulfur in coal). This form of characterization complements optical microscope studies and conventional transmission electron microscope (TEM) studies which have been used to classify and to study coal constituents. SEM offers a way to visualize features hundreds and thousands of Angstroms in diameter by direct observation in three dimensions which is not available by any other technique. Many significant coal features (such as cellular components) and impurity crystals occur in this size range. Important features of coal constitution discovered by SEM are discussed.

56379 Transient technique for measuring diffusion coefficients in porous solids. Diffusion in carbonaceous materials. Yang, R.T.; Liu, R.T.; Steinberg, M. (Brookhaven National Lab., Upton, NY). *Ind. Eng. Chem., Fundam.;* **16**: 486-489(Nov 1977).

A transient technique has been developed for measuring effective diffusion coefficients of gases in porous materials. The

technique is appropriate for measuring D/sub e/ in the range of 10^{-2} to 10^{-4} cm^2/s. Comparisons between this technique and other techniques are discussed. Diffusion of two binary gaseous systems in a nuclear graphite and in a bituminous coal has been studied with this technique.

56380 Microwave determination of the moisture content of coal fines. Hoberg, H.; Klein, A. *Glueckauf;* **113**: No. 17, 859-863(1 Sep 1977).

The suitability of the microwave method of determining the moisture content of coal fines has been investigated. Errors caused by differing salt contents can be avoided by taking the measurements at high frequencies. The effect of bulk density is negligible; it is not necessary to know the bulk density or volume of a sample. Errors arising from differences in size consist can be eliminated by measuring both the attenuation and the phase of the transmitted signal. Work continues on other possible disturbing factors, but the effect of these is small.

56381 New classification for Donbass coals. Kotkin, A.M. *Ugol Ukr.;* **21**: No. 7, 42-43(Jul 1977). (In Russian).

From the 1st January 1977 a new standard for Donets coals came into force. It is based on volatile matter, plastic layer thickness and Roga index. (In Russian)

56382 Possibilities of measuring engineering parameters in coal and mineral preparation. Lippek, E.; Uhlig, D. *Neue Bergbautech.;* **7**: No. 4, 289-294(Apr 1977).

This paper lists the parameters which are important in preparation processes, and briefly reviews the literature on the most usual methods of measuring solid, gas and liquid flow, particle size, density, moisture content, and the contents of containers.

56383 High-pressure sorption of methane on hard coal saturated with water vapor. Czaplinski, A.; Holda, S. *Zesz. Nauk. Akad. Gorn.-Hutn. Stanislawa Staszica, Gorn.;* No. 85, 53-60(1977). (In Polish).

Measurements of the high-pressure sorption of methane (to 150 atmospheres) on dry coal and coal saturated with water vapor were made at 296°K, the samples being Polish hard coals with different degrees of metamorphism. The results were presented graphically in the form of the excess sorption isotherms. Coal saturated with water vapor has a smaller sorptive capacity towards methane than dry coal. The greatest reduction of sorption takes place with long-flame coal, and the smallest with anthracite. These observations coincide with the physico-chemical structure of hard coal.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 56462, 57528

56384 (IS-M—142) Recovery of alumina from fly ash by high-temperature chlorination. Burnet, G.; Murtha, M.J.; Wijatno, H. (Ames Lab., IA (USA)). 1977. Contract W-7405-ENG-82. 6p. (CONF-7705131—1). Dep. NTIS, PC A02/MF A01.

From 3. coal refuse disposal and utilization seminar; Lexington, KY, USA (11 May 1977).

The large volume of fly ash being produced, largely in centralized locations, and the composition of the ash present unique opportunities for the recovery of minerals. A typical United States fly ash will contain about 21% alumina and 17% iron oxide, the balance being primarily silica. Up to 85% of the iron oxide can be removed from the ash by magnetic separation. Since 1972, three different processes for recovering alumina from the non-magnetic fraction of fly ash have been under investigation at the Ames Laboratory. The processes are lime-sinter, hydrochemical and high-temperature chlorination. Significant progress has been made with the latter and it will be discussed in detail. In the chlorination process, the non-magnetic fraction of the fly ash is mixed with carbon and chlorinated in a fixed bed. Because the iron has a high chlorine affinity, the iron remaining in the ash can be removed as volatile iron chloride at 400°C to 600°C; very little aluminum and silicon react. The temperature is then raised to 850°C to 950°C where a mixture consisting mostly of volatile aluminum and silicon chlorides forms. When the vapors are cooled, solid aluminum chloride condenses at 120°C to 150°C while the silicon tetrachloride remains in a vapor state because of its low condensation temperature. The silicon tetrachloride can be easily decomposed to form silica and HCl thus recycling the chlorine.

56385 (PB—277076) Emission testing and evaluation of Ford/Koppers coke pushing control system. Volume II. Appendices. Final report December 1973—August 1977. Cooper, F.; Loch, T.; Mutchler, J.; Vecchio, J. (Ford Motor Co., Dearborn, MI (USA)). Sep 1977. Contract EPA-68-02-0630. 600p. NTIS PC A25/MF A01.

The report documents a field testing and engineering evaluation of the performance of a retrofitted, mobile-hood, high-energy-scrubber control system, abating coke-side pushing emissions from a 58-oven coke battery. It documents the venturi-scrubber inlet and outlet emission rates, as well as emission factors for filterable and condensible particulate, sulfur dioxide, sulfur trioxide, total sulfur oxides, carbon monoxide, nitrogen oxides, benzene, benzene and homologues, total light hydrocarbons methane and homologues, and ethylene and homologues. Results indicate that the mobile hood collects particulate emissions resulting from green and clean pushes at 22% to 54% efficiencies, respectively, or from 30% to 92%, respectively, using two different estimating techniques. Scrubber performance averaged 99.3% for particulate emissions captured in the hood.

56386 (PB—278031) Evaluation of sulfate-bearing waste material from fluidized bed combustion of coals for soil stabilization. Final report. Nebgen, J.W.; Edwards, J.G.; Conway, D. (Midwest Research Inst., Kansas City, MO (USA)). Sep 1977. Contract DOT-FH-11-8515. 70p.

The effects of spent bed material from the fluidized bed combustion of coal in the physical and strength properties of selected fine-grained soils has been evaluated. The spent bed material is a mixture of lime and calcium sulfate (together with some fly ash) obtained from a process being evaluated by the Energy Research and Development Administration in which pulverized coal is burned in a fluid bed of finely ground calcitic or dolomitic limestone. Results of the study indicate that spent bed material is an excellent substitute for lime for soil stabilization. The material behaves as a mixture of lime, calcium sulfate, and fly ash towards development of unconfined compression strength when mixed with soils. It has been concluded that use of spent bed material for soil stabilization is a viable alternative to disposal when full-scale fluidized bed coal combustion plants become a reality.

56387 (PB—278140) Use of waste sulfate for remedial treatment of soils. Volume I. Discussion of results. Final report, 1 September 1974—30 September 1976. Nebgen, J.W.; Edwards, J.G.; Weatherman, D.F. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1976. Contract DOT-FH-11-8515. 217p.

The effects of waste sulfate (phosphogypsum from fertilizer manufacture, flue gas desulfurization solids, and neutralized acid mine drainage solids) on physical and strength properties of soils have been studied. Waste sulfate alone has little effect on soil strengths. However, if it is used in combination with lime, higher strengths can be achieved with waste sulfate/lime than can be obtained with equivalent lime treatment because of soil-sulfate-lime reactions. Fly ash can be used with waste sulfate/lime mixtures to improve strengths further. Cement kiln dust has been shown to be an effective substitute for lime as a soil stabilizer. The report is presented in two volumes. Volume I--Discussion of Results--describes the experimental work and contains the interpretation of data and conclusions and recommendations.

56388 (PB—278141) Use of waste sulfate for remedial treatment of soils. Volume II. Appendixes. Final report. Bebgen, J.W.; Edwards, J.G.; Weatherman, D.F. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1976. Contract DOT-FH-11-8515. 147p.

Volume II--Appendixes--contains an annotated bibliography of literature reviewed, Atterberg Limit, and moisture-density data for waste sulfate/soil systems, experimental unconfined compressive strength data, and an outline of multiple regression procedures used for data analysis.

56389 (TID—28654) Development of potential uses for the residue from fluidized bed combustion processes. Monthly technical progress report. Minnick, L.J. (Minnick (L.J.), Inc., Plymouth Meeting, PA (USA)). Jun 1978. Contract EF-77-C-01-2549. 13p. Dep. NTIS, PC A02/MF A01.

Residues from the Battelle FBC boiler and the one at Alliance, Ohio, have been received and evaluated. Pore volume data appear to offer an explanation for the difference in reactivity between the Alexandria and Rivesville residues. Efforts to identify the proper conditioning procedures have continued and several methods show promise. Additional preparations for the road base demonstration have been made. Chemical analyses of new residues from Alliance, Ohio and Battelle gave substantially different results. The Alliance material showed low loss on ignition, low silica content and very high lime content. The lower pore volume of the Rivesville residue compared with the Alexandria residue supports the supposition that the sulfate coating on the oxide grains is thicker on the Rivesville material. This may explain the slower reaction rate of the CaO present in the Rivesville residue. An addition of at least 15% of water by weight to the Rivesville residue followed by an aging period of at least 5 days eliminated detrimental expansion of compacted, stabilized, cylindrical test specimens. This "conditioning" procedure was not necessary with the Alexandria residue.

56390 Molybdenum extraction from wastes of fossil coal reprocessing. Zelikman, A.N.; Rakova, N.N.; Zekel, L.A.; Krasnobaeva, N.V.; Shpirt, M.Ya. *Tsvetn. Met.;* No. 8, 53-54(Aug 1977). (In Russian).

To obtain valuable chemical products in the hydrogenization process of hydrogeneous coal in mixtures with high-sulfurous petroleum products the iron-molybdenum catalysts are used. In coal processing molybdenum goes into a slime remaining after coal hydrogenization. A slime rational composition has been investigated. A process flow diagram of molybdenum extraction is suggested which provides for the closed process without waste disposal as well as permits to spare expensive and deficit molybdenum.

56391 Cleaning up stack gas without production of unsalable byproducts. Hennico, A. (Institut Francais du Petrole, Paris); Odello, R.; Frankowiak, S.; Salvat, J.; Dezael, N.; Bonnifay, P.; Cha, B.; Andrews, J.W. *Proc. Am. Power Conf.;* **39**: 327-335(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The IFP stack gas cleanup process, also known as STACKPOL 150, was conceived and developed as an advanced flue gas desulfurization process. By using a clear liquor scrub, the process avoids the obvious scaling problems, does not require constant replacement of absorbent and catalysts, produces a salable sulfur, and does not generate objectionable byproducts that by themselves create handling and or disposal problems. A three-month continuous run at the EDF plant has proven that the IFP process is a reliable second-generation flue gas cleanup process. The process is commercially available in fields of application such as desulfurization of chemical and refinery off-gases—the Stackpol process can be easily adapted to the cleaning up of Claus tail gases or sulfuric acid off-gases; reduction of overall SO/sub x/ emissions in industrial complexes (such as refineries). Several scrubbers can be installed near the different flue gas source feeding a single brine treatment section; and desulfurization of flue gases in the electric power industry.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 56343, 56353, 56354, 56425, 56458, 56943, 57523, 57624

56392 (BNWL-SA—6525) **Land restoration after strip mining for coal.** Rickard, W.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 14p. (CONF-7709149—1). Dep. NTIS, PC A02/MF A01.

From Symposium on land restoration after strip mining for coal; Juneau, AK, USA (21 Sep 1977).

Recent legislation requires that lands surface mined for coal be returned to approximate original topography and vegetative cover be restored. Spoils provide poor rooting habitat because of extreme stoniness or excessive slope steepness which provide few niches for seeds to become lodged and also spoil may provide poor mineral nutrition, poor water retention and sometimes the spoil may even have chemical properties detrimental to plant growth (acidity, alkalinity or even unusually large amounts of toxic mineral elements i.e., copper, sodium). To provide a substrate better suited for plant growth, recommendations for restoration call for deep burial of unfavorable substrate components i.e., rocks and materials of unusual chemistry and the dressing of reshaped spoil with topsoil i.e., material with the most favorable properties for plant growth. Even though all the substrate requirements for healthy plant growth may be met, such as adding a form of available nitrogen as fertilizer, plants will not grow if weather conditions are extreme. For example, in very dry (desert) climates precipitation may be too scanty or too erratic to permit the successful establishment of many kinds of plants. Even under the most favorable conditions plant productivity averaged over a period of years is low. Also in very cold climates the growing season may be limited to only a few weeks in summer e.g., arctic and alpine tundra regions. This shortens the time available for photosynthesis and keeps plant productivity low.

56393 (PB—278333) **Environmental assessment of coal liquefaction. Annual report, July 1976—September 1977.** Budden, K.T.; Zieger, W.H. (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1978. Contract EPA-68-02-2162. 202p. NTIS PC A10/MF A01.

The report summarizes results of a study of the environmental aspects of 14 of the most prominent coal liquefaction systems, in terms of background, process description, major operations, input and output streams, status, and schedule of system development. As a result of the study, four systems--SRC, H-Coal, Exxon Donor Solvent, and Synthoil--were selected for in-depth study. The first Standards of Practice Manual, under preparation for the SRC-I system, will include descriptions of modules, control/disposal practices, environmental emissions, and control/disposal costs.

56394 Carbon dioxide problem: solution by technical countermeasures. Bach, W. *Umsch. Wiss. Tech.;* **78**: No. 4, 117-118(15 Feb 1978). (In German).

A rough assessment indicates that anthropogenic influences might raise the mean global surface temperature by 0.8 to 1.2 C in 2000 AD and by 2 to 4 C in 2050 AD. The rapidly increasing levels of atmospheric carbon dioxide are largely responsible for this warming trend. A variety of measures for the reduction of carbon dioxide emissions is presented. One promising approach is to work out a world-wide energy mix that can counteract a temperature increase. (In German)

56395 Determination of the surface predominance of toxic elements in airborne particles by ion microprobe mass spectrometry and Auger electron spectrometry. Linton, W.; Williams, P.; Evans, C.A. *Anal. Chem.;* **49**: No. 11, 1514-1521(Sep 1977).

Surface analytical techniques including ion microprobe mass spectrometry and Auger electron spectrometry have been used to demonstrate elemental surface predominance in coal fly ash particles. Substantiation and quantitation of the microprobe data were achieved by using a multitechnique approach including solvent leaching and bulk multielemental analysis using spark source mass spectrometry. Elemental surface predominance is explained in terms of a volatilization-condensation mechanism. The substantial leachabilities and strongly enhanced surface region concentrations of numerous elements, including potentially toxic ones such as Pb, Tl, Mn, and Cr, indicate that coal fly ash may have a more deleterious environmental impact than is apparent solely on the basis of conventional bulk analysis.

56396 Climatic effects related to production and use of fossil fuels. Williams, J. Laxenburg, Austria; International Inst. for Applied Systems Analysis (1977). 45p.

Two aspects of the climatic effects of fossil fuel use are considered: firstly the local effects of release of waste heat, gases and particulates which are observable at the present time and secondly, the potential global climatic effects of carbon dioxide and waste heat. The many uncertainties involved in assessing possible impacts of energy strategies on global climate are emphasized.

56397 Summer soil temperature as a factor in revegetation of coal mine waste. Paper 77-1A. Harrison, J.E. pp 329-332 of Report of activities, Part A. Ottawa; Geological Survey of Canada (1977).

A study of reclamation of coal cleaning plant tailings disposal areas indicated that high summer soil temperatures are an important factor in revegetations. Discusses: (a) composition of the coal waste; (b) variation of surface temperature with time, aspect, slope elevation, and depth; (c) moisture conditions; (d) thermal properties; and (e) implications of the data for revegetation.

56398 Coal mining and surface water quality: Crowsnest Pass, Alberta, and British Columbia, preliminary data. Paper 77-1A. Harrison, J.E. pp 319-322 of Report of activities, Part A. Ottawa; Geological Survey of Canada (1977).

Data from 35 water samples gathered near operating and abandoned coal mines are presented in tabular form. It is concluded that coal mining increases total dissolved solids, total alkalinity, total hardness, iron, and sulphate contents in surrounding water. Chemical oxygen demand may be high under certain circumstances, and field observations indicate suspended solids represent a serious threat to water quality.

56399 Rehabilitation of streams receiving acid mine drainage. Herricks, E.E.; Cairns, J.J. Blacksburg, VA; Virginia Water Resources Research Center (1977). 290p.

Experiments were carried out on the effect of short-term additions of acid to a healthy productive stream on the rate of disappearance and recovery of benthic organisms, and field studies were also undertaken on the effects of acid mine drainage on a typical stream system over a 2-year period. Changes in the distribution of organisms by the flow of tributaries and the extent of dilution of the acid waste were recorded. In addition to the biological studies, hydrologic and water-quality models were derived and applied to the conditions observed. A second stream study, involving the effect of lime neutralization on the recovery process, showed that the formation of hydroxide floc produced a secondary stress in some cases.

56400 Effects of human activities on global climate. Kellogg, W.W. Geneva; World Meterological Organization (1977). 49p.

At present it is difficult to make any predictions for the natural course of climate in the next several decades. However by using climate models, predictions of the cause of climate changes as a result of anthropogenic influences can be made, other external factors remaining the same. Experiments with a number of different models have converged on approximately the same conclusions: the largest single effect of human activities on climate is due to an increase in atmospheric carbon dioxide concentration through fossil

fuel combustion, i.e., air and thermal pollution, which contributes to a warming of the lower atmosphere; the best estimate of the warming of the mean surface temperature of the earth is about 1C by 2000 AD and 3C by 2050 AD with 3 to 5 times that increase in polar regions, and an uncertainty of roughly a factor of two. These conclusions assume a continued quasi exponential rate of release of carbon dioxide to the atmosphere. Absorption of the added carbon dioxide is expected to take between 1000 and 1500 years. If all economically recoverable fossil fuel is burned in the next few centuries, the atmospheric concentration of carbon dioxide would increase by 5 to 8 times. An example of a natural warming on a similar scale to that expected in the middle of the next century occurred 4000 to 8000 years ago. Generally there was more rainfall especially over the present sub-tropical deserts, but some regions in middle and high latitudes were drier than now. The extent of Arctic and Antarctic sea ice would be influenced. The total volume of the major ice sheets would change, but a change in sea level cannot yet be predicted with any confidence.

56401 Method for predicting the change in the composition of mine waters in coal mines of the Donets Basin. Panasenko, G.P. pp 66-72 of Geol. Str. Razved. Polezn. Iskop. Nizhnego Dona. Rostov-on-Don, USSR; Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR) (1974).

Equations correlating the concentration of K, Na, Ca, sulphate and Cl in mine waters with the depth of mining operations are developed. The error of the equations was less than 15 to 20 percent. Direct correlation for Mg, sodium bicarbonate and suspended matter was not established, but secondary equations based on the dependence of Mg and sodium bicarbonate concentration on the concentrations of the other ions quoted above were developed.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 57065

56402 Basis for classification of rocks by their strength properties. Bakhtin, G.A. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 2, 208-211(Mar 1978).

This paper describes a classification based on the method of principal components, in which the action of a number of measured variables is replaced by a smaller number of unobserved quantities, and the nonvariance which arises is removed by a special scaling method. The classification has been used on overburden rocks in coal fields.

56403 Petrography of some shallow coal seams on the eastern flank of the Galilee Basin. Beeston, J.W. *Queensl. Gov. Min. J.;* **78**: No. 908, 264-267(Jun 1977).

The coals on the eastern flank of the Galilee Basin are low rank, subhydrous, and range from thin, bright seams in the south to thick, dull seams in the north.

56404 Petrographic assessment of the German Creek seam, Central Queensland. Beeston, J.W. *Queensl. Gov. Min. J.;* **78**: No. 906, 181-190(Apr 1977).

The German Creek formation is thickest and brightest in two main areas where peat accumulation was most prevalent. A high reactives content is a characteristic of the seam throughout these areas, both laterally and in vertical section. Greater maximum depth of burial in the northeast of the region has resulted in a rank increase in that direction, with minor variations over the Comet Ridge, the coal ranging from sub-bituminous to semi-anthracitic. The consistently high reactives content and wide rank range of the seam have rendered its coking parameters amenable to regular and precise delineation.

56405 Complex use of introscopy methods in borehole exploration. Yamshchikov, V.S.; Shabel'nikov, A.V. *Ugol;* No. 3, 64-66(Mar 1977). (In Russian).

Existing methods of face introscopy of technical boreholes from mine workings are examined. The electrometric method of borehole exploration is presented along with test results using that method. 2 illustrations.

56406 Applications of nuclear techniques in the coal industry. Clayton, C.G. (UKAEA Research Group, Harwell Atomic Energy Research Establishment). pp 85-117 of Nuclear techniques and mineral resources 1977. Vienna; IAEA (1977).

From IAEA international symposium on nuclear techniques in exploration, extraction and processing of mineral resources; Vienna, Austria (7 Mar 1977).

The applications of nuclear techniques in exploration, mining and coal preparation in particular have been reviewed. It is shown that, following early applications of density and level gauges, and largely as a result of the renewed position of coal as a world energy resource, the application of nuclear techniques is increasing substantially. Methods of measuring directly a number of economically important properties of coal, especially during borehole logging and in coal preparation plants, are currently being actively developed.

56407 Canadian government coal block, Parcel 73, Fernie Basin, British Columbia, paper 77-1A. Ollerenshaw, N.C. pp 155-159 of Report of activities, Part A. Ottawa; Geological Survey of Canada (1977).

A report on geological mapping and a detailed structural investigation to determine the quantity, distribution and geometry of the coal reserves is given. The block covers about 7.5 square miles in southeastern British Columbia. The stratigraphy and geological structure of the area are discussed.

56408 Devonian coal in the subsurface of the Great Slave Plain: a guide to exploration for oil and gas, paper 77-1A. Gunther, P.R.; Meijer-Dreer, N.C. pp 147-150 of Report of activities, Part A. Ottawa; Geological Survey of Canada (1977).

Examination of cores from exploratory wells in the southern Mackenzie District, Northwest Territories revealed the existence of very thin coal seams and coaly plant fragments in beds transitional between Middle and Upper Devonian. The stratigraphy of the seams is shown graphically and their complex relationships discussed. Vitrinite reflectance values for coal samples suggest a useful method by which to zone the area laterally into regions of varying potential for oil and gas exploration.

56409 Occurrence of coal in the Blairmore Group on Waiparous Creek, Central Foothills, Alberta. McLean, J.R. pp 151-154 of Report of activities, Part A. Ottawa; Geological Survey of Canada (1977).

A coal seam 4.25 m thick has been found in outcrop on Waiparous Creek in the Blairmore Group, which forms the basal unit of the Lower Cretaceous in the Foothills of western Alberta. A stratigraphic chart and a log of the stratigraphic section are shown and discussed.

MINING

REFER ALSO TO CITATION(S) 56392, 56399, 56401, 56406, 56471, 56472, 56473, 56474

56410 (FE—9012-5) Shortwall mine availability and delay analysis. Vol. 2. Appendices. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1976. Contract ET-75-I-01-9012. 123p. Dep. NTIS, PC A06/MF A01.

56411 (LBL—6334) Energy utilization and environmental control technologies in the coal-electric cycle. Ferrell, G.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1977. Contract W-7405-ENG-48. 201p. Dep. NTIS, PC A10/MF A01.

This report presents an overview and assessment of the currently commercial and possible future technologies in the United States that are a part of the coal-electric cycle. From coal production to residual emissions control at the power plant stack, this report includes a brief history, current status and future assessment of each technology. It also includes a discussion, helpful for policy making decisions, of the process operation, environmental emission characteristics, market constraints and detailed cost estimates for each of these technologies, with primary emphasis on coal preparation, coal-electric generation and emissions control systems.

56412 (PB—277265) Continuous recorder to monitor mine roof displacement. Technical progress report. Radcliffe, D.E.; FitzSimmons, J.R. (Bureau of Mines, Denver, CO (USA). Denver Mining Research Center). Dec 1977. 17p. (BM-TPR—104).

This report describes an instrument system developed by the Bureau of Mines to continuously monitor and record changes in roof displacement during underground mining activity. The instrument consists of a single wire extensometer coupled to a mechanical drive chart recorder mounted in an aluminum frame installed in the roof. The unit is small and simple to install and meets safety requirements for use in underground coal mines.

56413 (PB—277987) Development of optimized diffuser and spray fan systems for coal mine face ventilation. Interim report. Wallhagen, R.E. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Nov 1977. Contract H0230023. 256p. NTIS PC A12/MF A01.

This report describes the results of a 4-year investigation into improved face ventilation systems for underground coal mines. The objective was to experimentally determine configurations for a diffuser fan system and a water spray (spray fan) system that will provide a maximum reduction in face methane concentrations without causing an increase in methane concentrations at the operator's position. The experimental evaluation was performed in full-scale

mock-up mine entries, simulating continuous mining operations in both a 6-foot and a 4-foot coal seam complete with normal ventilation, water sprays, and methane emission. A limited study was also performed to assess the effect of scrubber discharge location on methane concentrations in the face area. The results indicate that diffuser fan and spray fan systems that were designed to augment the natural airflow pattern in the entry could provide a factor of 3 to 5 reduction in average methane concentration at the face, compared with a mining machine with just conventional water sprays. The properly designed diffuser and spray fan systems also significantly reduced the total methane present in the entry. A properly designed dust scrubber discharge can reduce face methane levels by a factor of 2.

56414 (PB—278561) **Effects of hydraulic stimulation on coalbeds and associated strata. Report of investigations.** Elder, C.H. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Mining and Safety Research Center). 1977. 27p. (BM-RI—8260). NTIS PC A03/MF A01.

In studies conducted by the Bureau of Mines, two test areas were hydraulically stimulated and exposed by mining: One in the Pittsburgh coalbed at the Vesta No. 5 mine, Washington County, Pa.; and one in the Illinois No. 6 coalbed at the Inland mine, Jefferson County, Ill. Induced fractures were contained totally within the coalbed with no adverse effect on the stability of associated rock strata. Induced fractures were vertical and were propagated normal to the direction of least residual tectonic stress. Gas production was increased fivefold to twentyfold by hydraulic stimulation. Hydraulic stimulation is a process developed by the oil industry for increasing productivity of a reservoir. Vertical test holes drilled in advance of mining have been hydraulically stimulated to degasify the coalbed more efficiently by increasing the gas flow. The procedure consists of inducing fractures in a coalbed by applying hydraulic pressure with controlled injection of gelled water and propping sand. The fractures are propagated several hundred feet into the coalbed by pumping large volumes of the treatment fluid. Flow characteristics of the fluid and size of propping sand were found to affect the length and width of the induced fracture. Concern for maintaining the integrity of mine roof and floor has deterred coal mine management from applying hydraulic stimulation to increase gas flow from vertical degasification boreholes in advance of mining. This concern motivated the Bureau of Mines to investigate the effects of the stimulation treatment on coalbeds and the rock strata that form the roof and floor of the mine.

56415 Method of and apparatus for the mining of coal. Paurat, F.W. US Patent 4,095,845. 20 Jun 1978. Priority date 26 Jul 1975, German, Federal Republic of (F.R. Germany). 8p.

An excavating mining and conveying apparatus is formed of trough segments or sections with screw sections mounted on the trough sections carrying out the mining and conveying functions. Actuating means are provided to bring screws successively into inclined contact with the face or seam of coal at an angle of from 5 to 50°. A drive is provided to transmit a torque to drive the conveying and transporting screws.

56416 Rack device for a mining machine. Lanfermann, W. (to Gebr. Eickhoff, Maschinenfabrik und Eisengiesserei m.b.H.). US Patent 4,082,361. 4 Apr 1978. Priority date 10 Jul 1975, German, Federal Republic of (F.R. Germany). 10p.

A rack device extends along the side wall of a face conveyor for a mining machine and essentially includes a plurality of elongated rack segments supporting spaced-apart drive members along the length of each segment. The rack segments are joined together in an end-to-end relation by a rod member passed through an eyelet opening in extensions projecting from the rack segments. The rod member is arranged at the joint between rack segments such that the rod member lies between, preferably midway between, adjoined sections of the face conveyor. A duct extends between the side wall of the face conveyor and a spill plate which is formed by a plurality of plate members arranged side-by-side to extend along the face conveyor. The duct has upstanding side walls with openings to receive and support the rod member used to join together the rack segments. The openings in the extensions of the rack segments as well as the openings in the side wall of the duct member are elongated for limited longitudinal movement of the rack segments in relation to the face conveyor. Further details and modifications are disclosed.

56417 Mining apparatus and method. Campbell, J.A.L.; Moynihan, D.J. (to Peabody Coal Co.). US Patent 4,082,360. 4 Apr 1978. Filed date 23 Jun 1976. 8p.

An articulated ancillary support for a conveyor is attached onto the forward side of a mine roof chock by extensible means which, when retracted towards the chock, shifts the ancillary support from a normal condition in which it occupies an area of relatively wide lateral extent to another condition in which it overlies an area of relatively narrow lateral extent, freeing a large portion of the space under the chocks to clear the way for a retreating continuous miner.

56418 Geological environment in relation to longwall operation in the USA. Buck, W.A. *Min. Eng. (London);* **137**: No. 199, 363-371(Feb 1978).

After making reference to the important contribution made by longwall operations to coal production in the United States, a description is given of the geology of the northern section of the Appalachian Basin in relation to geological structure and stratigraphy. Within the study area the three seams generally worked by underground methods are the Pittsburgh, Lower Freeport and Lower Kittanning, and these are examined in relation to the mines visited. Finally, reference is made to the production figures for the longwall units visited and consideration is given to the potential of the longwall system in the USA.

56419 Power loader developments in North Derbyshire. Harrison, J.W. *Min. Eng. (London);* **137**: No. 199, 351-361(Feb 1978).

This paper describes the progress of two power loader development programmes directed towards improving coal face performance. Factors contributing towards the present popularity of the double-ended conveyor-mounted trepanner in the thinner seams are indicated. The development of the twin fixed-turret trepanner and the operational advantages obtained in the initial trial of this machine are discussed. The background to the instigation of a Wide Web Working Party in North Derbyshire Area is given and the proposed programme of progressive increase of web depth described. The primary phase of the practical trials, the installation of an "In-Web" Shearer, is described in detail and problems experienced during the early days of production explained. nally, conclusions are drawn as to the future of power loaders in North Derbyshire. In the thinner seams there is a need for a higher powered replacement for the 120 horse power trepanner, preferably incorporating facilities for wide web application, capable of working down to 30 in. (76 cm) seam section. Wider web working will need to be pursued in the thicker measures utilizing proven equipment.

56420 Westfield open pit. Anderson, E. *Min. Eng. (London);* **137**: No. 199, 337-346(Feb 1978).

This paper discusses the Westfield Open Pit, on the Kinross and Fife Boundary. The major open-pit works and the operation of the washery commenced in January 1961 and to the present time over 21 million tons of coal has been mined and processed and nearly 100 million cubic yards of excavation works achieved. The saleable product from the coal has amounted to nearly 14 million tons of washed coal and over 1.5 million tons of slurry product. The coals mined at Westfield are from the Boglochty coalfield and lie in the Passage Group. The configuration of the deposit did not lend itself to mining in the normal opencast coal methods used in Britain and the scheme adopted consisted of loading the material, using excavators, into trucks for transportation, originally to a crushing station for further transport by belt conveyor to a dump outside the mining area, and later to backfill dumps in the mined out areas. The pit was mined in three stages. The first stage (Phase I) necessitated the removal of up to 40 ft of peat and sand by dredging and the excavation of a box cut capable of receiving the waste from the second stage (Phase II). The waste from the box cut was transported to Moss Plantation where an artificial hill was formed. The void created by Phase II operations was able to accommodate the third stage (Phase III) waste material.

56421 Computer control of conveyors and the environment. Massey, C.T. *Min. Eng. (London);* **137**: No. 199, 325-336(Feb 1978).

This paper considers the impact of modern high output coal faces on coal conveying systems and on the environment of the mine. The suitability of the traditional tools of the mining engineer for handling and controlling conveyors and the environment is assessed. The technology of computer control, which is now available and in use at several pits, is described and evaluated as a new practical operating tool for the mining engineer. Operating experience from several collieries is included and a part of the paper attempts to identify the costs and financial implications of the scheme so far commissioned. Some of the issues raised by this new technology are identified and considered.

56422 Final report of the National Committee on steep seam working in British coal mines. London; Her Majesty's Stationery Office (1978). 23p.

This report considers all aspects of planning, development, and working including supports and support systems in British coal mines. Research and development and extensive field trials mainly at Seafield Colliery are described. The trials were on gradients up to 50 degrees. Methods of increasing safety are recommended.

56423 NCB tests linear motor underground train. *Electr. Times;* No. 4455, 6(9 Dec 1977).

Brief details are given of tests on a prototype 32 seat linear motor powered manrider. Advantages of this kind of train include its ability to carry loads up steep gradients without slipping, and the fact that arcing is avoided, thus reducing the danger of explosions.

56424 Causes of dynamic loads on face supports. Zamarski, B. *Uhli;* **25**: No. 11, 466-469(Nov 1977). (In Czech).

Sometimes face supports are damaged by dynamic loads. The reasons for these dynamic loads are outlined. (In Czech)

56425 Site investigation at Irvine: a new town's approach to ground exploration. Couchie, W.G. *Ground Eng.;* **10**: No. 8, 28-32(Nov 1977).

Located within the Ayrshire coalfield the designated area of the new town has a past history of coal mining in thirteen workable seams. More than 160 old shafts are recorded. Major ground stability problems are associated with the earlier worked shallow seams and old abandoned shafts.

56426 Poor markets, lack of incentives cause drastic drop in capital spending. Fish, R. *Can. Min. J.;* **98**: No. 10, 10-14, 19(Oct 1977).

Canadian Mining Journal's 1977 Capital Expenditure Survey shows a drop of 52% in announced spending intentions compared with the 1976 survey total. Coal is particularly hard hit with announced spending for 1977 at 1,250,000 dollars as compared to 700,770,000 in 1976. This total 1977 amount is reported by Kaiser Resources for installing a Honeywell Model 66/05 large scale computer system to be used for accounting, inventory control, engineering and material procurement applications at Sparwood.

56427 Determination of the relationship between geometrical parameters and ventilation and drag of longwall faces worked with hydraulic stowing. Demel, T. *Przegl. Gorn.;* **33**: No. 9, 408-414(Sep 1977). (In Polish).

On the basis of theory and measurements, a formula was deduced for ventilation and drag in longwall faces worked with hydraulic stowing. (In Polish)

56428 How gas in seams affects heatings and liability to spontaneous combustion. Vinogradova, L.P. *Ugol;* **52**: No. 9, 24-26(Sep 1977). (In Russian).

Laboratory experimental work is described in which an attempt has been made to correlate the rate of sorption of oxygen with the residual methane content of the coal. (In Russian)

56429 Continuous miner sold to Coalbrook collieries. *S. Afr. Min. Eng. J.;* **88**: No. 4131, 13(Aug 1977).

Coalbrook Collieries bought a continuous miner that has a capacity of 8 to 12 tonnes/min from Joy Manufacturing Co. (Africa) (Pty) Ltd. Features include high capacity-low maintenance performance coupled with rugged construction.

56430 Situation in the Spanish energy sector. Fernandez Felgueroso, J.M. *Ind. Miner.;* **59**: No. 8/9, 425-430(Aug 1977). (In French).

In Spain, the use of coal and of nuclear energy will increase. It is planned to double 1976 production and produce 9.1 million tonnes of coal, 4.8 million tonnes of anthracite, and 19.8 million tonnes of lignite in 1979.

56431 Resin assisted bolting. Kara, V.V. *Ugol Ukr.;* **21**: No. 7, 20-22(Jul 1977). (In Russian).

The technique of resin bolting is described and examples of schemes for its application on the face and at the ripping lip are given. (In Russian)

56432 Transport in deep coal mines. Pluta, L. *Przegl. Gorn.;* **33**: No. 7/8, 320-330(Jul 1977). (In Polish).

In some Polish mines, shuttle traffic is organized so that coal, men and materials can be carried by the same means of transport along the same roadways, thereby reducing considerably the number of roadways and excavations required. Trains carrying over 6000 tpd are loaded from one point. Labor requirements for transport have been reduced.

56433 Economic analysis of pit slope design. Kim, Y.C. *CIM Bull.;* **70**: No. 783, 100-108(Jul 1977).

A proper analysis of pit slope design must reflect the trade-off between the benefits and the increased risk of slope failure inherent in steeper sloped angles. However, no formal framework for a proper analysis has existed to date. Summarizes the material contained in the Design Chapter Supplement of the Pit Slope Manual (in preparation for publication by CANMET, Ottawa). The supplement describes the results of the research effort in which a formal economic analysis framework was developed and tested through a case study. The case-study results have demonstrated the practicality of the developed procedure and the availability of required data under 'real-life' conditions.

56434 Statistical aspects of coal mining during 1975. *Ind. Miner., Mine;* No. 3, 184-191(Jun 1977). (In French).

This paper gives statistics covering the operation of the nationalized coal mines in France in 1975 covering the number of shifts worked; production; equipment; explosives; winning and loading; stoving; support; and ventilation.

56435 Emergency devices and automatic brakes. Lester, C.E. *Ind. Miner., Mine;* No. 3, 151-160(Jun 1977). (In French).

This paper stresses the necessity of installing emergency devices which allow a rapid cutoff of power in the case of emergency and the use of automatic emergency brakes for powered machines used in mines. Sketches showing fatal accidents in underground coal mines are presented together with security devices which could have prevented them. There are also drawings and technical information to help users and equipment manufacturers to study, install and maintain emergency equipment.

56436 Rock breaking using cutting discs. Pechalat, F. *Ind. Miner., Mine;* No. 3, 138-144(Jun 1977). (In French).

A Cerchar article describes the overall work undertaken in various countries concerning the relation between different rocks and tools, in order to fix the best methods of winning coal by the use of cutting discs. Discusses the principal types of cutting discs; the most important parameters to take into account; and some theoretical considerations. An experimental study of individual tools is described, including the principles governing compression force and cutting force, and the influence of the rock mass characteristics. Describes an experimental study of tool assemblies. A comparison between laboratory studies and observation on site and the relation between the rate of advance and nature of ground worked are given.

56437 State of investigations in the range of forecasting and combating rock bursts. Szezurowski, A. *Przegl. Gorn.;* **33**: No. 5, 198-201(May 1977). (In Polish).

Some problems connected with combating rock-burst hazards are discussed. The known and used methods of forecasting and combating rockbursts are given as well as the main trends of activity toward controlling the hazard. (In Polish)

56438 Status, trends, and developmental paths for the automatic control system of technological processes in mines. Gol'din, M.A.; Boronin, V.F. *Ugol;* No. 3, 48-52(Mar 1977). (In Russian).

Results are cited for work done on automatic control systems for technological processes in mines during the ninth fifth year plan, and the systems' trends and developmental paths are examined. 4 tables, 1 illustration.

56439 Prevention of endogenic fires and their extinction by foam. Igishev, V.G. *Ugol;* No. 3, 60-63(Mar 1977). (In Russian).

The possibility of using water—air foams in a worked-out section of seams is substantiated. 1 table, 3 illustrations, 4 references.

56440 Drying perbituminous coal with the aid of a leading gallery. Momchilov, V.S.; Labazkin, P.G.; Kharchev, V.N. *Ugol;* No. 3, 63-64(Mar 1977). (In Russian).

Test results are presented for draining perbituminous coal seams with the aid of an advance gallery in the Sub-Moscow basin. The coal seams have underground water in them.

56441 Wetting of complex structured coal. Panov, G.E.; Bondaev, B.P. *Ugol;* No. 3, 16-19(Mar 1977). (In Russian).

Research results are presented on the effectiveness of wetting coal seams in order to control dust formation in mines. 2 tables, 3 illustrations.

56442 Methodology for designing mine cable circuits for thermal stability. Minovskii, Yu.P.; Muratov, A.S.; Ikhno, V.A. *Ugol;* No. 3, 19-21(Mar 1977). (In Russian).

A methodology is presented for designing mine cable circuitry for thermal stability which takes into account basic factors that enhance the optimal utilization of materials used in cable construction.

56443 Improving the safety and efficiency of the pillar mining of sloping burst prone seams. Zel'vyanskii, A.Sh.; Bakulin, N.V.; Kaufman, L.L. *Ugol;* No. 3, 31-33(Mar 1977). (In Russian).

Alternatives of pillar mining are examined from the viewpoint of providing workers with two fresh air vents following the ejection of coal and gas in the long working face.

56444 Effect of an extracted layer's thickness on the productivity of single-bucket excavators. Novikov, V.V.; Ustyuzhanin, V.S.; Antipin, Yu.V. *Ugol;* No. 3, 34-35(Mar 1977). (In Russian).

Results of tests conducted to establish the nature of productivity changes in single-bucket excavators in separate excavation operations are presented. 2 tables.

56445 Complex mechanization of track operations in the pits. Matantsev, A.I.; Luzin, N.P. *Ugol;* No. 3, 35-36(Mar 1977). (In Russian).

The improvement of intra-quarry railways is discussed. 3 tables.

56446 Automatic control apparatus for the Luch-1 deep-well pumps. Ofitserov, V.Ya.; Kalitin, V.N.; Katkova, G.I. *Ugol;* No. 3, 42-44(Mar 1977). (In Russian).

Characteristics are given for the "Luch-1" apparatus, designed by the Moscow Region Scientific Research, Planning and Design Institute of Coal, intended for the automatic control of deep-well pumps. 2 illustrations.

56447 Mine tests of GAUSS type apparatus. Starikov, B.Ya.; Poyarelya, V.A.; Enenkov, B.I. *Ugol;* No. 3, 44-47(Mar 1977). (In Russian).

Results are cited for industrial tests made on experimental models of GAUSS apparatus. These installations are designed for the remote-control of drilling equipment and for oral communications between sections of the longwall.

56448 Room and pillar mining using spherical blasting charges. Lang, L.L. *Ind. Miner., Mine;* No. 3, 145-150(1977). (In French).

With a spherical charge (the ratio between diameter and length should not exeed 1/6) the thrust produced by the gas pressure is directed radially from the centre of the explosive mass, whereas with a cylindrical charge the thrust is principally directed perpendicularly from the charge hole axis. In a new application, the spherical charge is inserted in a vertical hole to a suitable depth, so that an inverted crater is formed pointing toward a horizontal open surface above the hole, which is the roof of an empty chamber. This method was applied to cutting a pillar 49 metres long by 6 m wide by 20/26 metres high. The advantages of this new practice are discussed and cylindrical and spherical charges are compared. (In French)

56449 Use of a remote controlled Wagner ST-2-B load-haul-dump in sublevel caving operations at the Cagnac mine of Houilleres d' Aquitane. *Publ. Tech. Charbon. Fr., Inf. Tech.;* No. 3, vp(1977).

Loading broken down coal is done by the Wagner ST-2-B loader but the distance the machine can penetrate the heap is limited, as the driver must not in any case, advance into an unsupported zone. Some of the mined coal is therefore lost. By driving the truck through remote control, it can be advanced deeper into the heap and this increases the proportion of broken coal recovered. Describes the use of remote control by cable and gives details of its installation. Safety and ergonomic aspects are discussed. Analysis of results reveals that the improvement in output from the district due simply to remote control of loader trucks can be estimated at 16 percent.

56450 Pit slope manual, chapter 9: waste embankments. Coates, D.F.; Yu, Y.S. (eds.). Ottawa; CANMET (1977). 137p.

Waste embankments include tailings dams, rock dumps, and overburden or soil dumps. The design specifications in the manual deal primarily with stability with some consideration given to the effects on natural water courses and groundwater. Design for stability takes into account the strength of foundations, maximum slope angle that will be stable in the long term even after the mine has shut down, natural drainage, and for coal wastes, spontaneous combustion.

56451 Study of physiocochemical processes liable to affect methane drainage from an anthracite seam. Artemov, A.V. *Fiz.-Tekh. Probl. Razrab. Polezn. Iskop.;* No. 4, 56-61(1976). (In Russian).

The molecular structure of anthracites is discussed, and liquids suitable for improving gas emission from anthracite seams are suggested. Infusion of the seam with ethylene glycol solution makes it possible to increase methane emission in drainage boreholes by eight or nine times.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 56338, 56397, 56406, 56411, 56467, 56944

56452 (IS-M—147) Relative floatability of coal and pyrites. Patterson, E.C.; Lee, H.V.; Ho, T.K.; Wheelock, T.D. (Ames Lab., IA (USA)). May 1978. Contract W-7405-ENG-82. 17p. (CONF-780611—13). Dep. NTIS, PC A02/MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

In order to enhance the separation of coal and pyrites by froth flotation or selective oil agglomeration, various surface treatments were applied to these materials, and the effectiveness of the treatments was determined by measuring the relative floatability of the treated products. In addition, the effectiveness of the treatments was assessed through oil agglomeration. It was shown that an oxidative chemical treatment reduces the floatability of the pyrite particles while not affecting the floatability of the coal. Also this treatment improves the selectivity of the oil agglomeration process for coal.

56453 Towards large-cell flotation plants at Ruhrkohle AG. Becker, M. *Glueckauf;* 113: No. 19, 952-955(6 Oct 1977).

The findings of RAG and SKBV's flotation working party relating to large-cell flotation plants are presented, and large-cell plants at Rheinpreussen, Lohberg, and Friedrich Heinrich washeries are described.

56454 Testing time for hydraulic pipelines. Walko, J. *Process Eng.;* 60-62(Oct 1977).

Details are given of testing facilities for hydraulic conveying at BHRA and Warren Spring Laboratory, and of some of the projects currently being carried out there. Information on pipeline work at Ruhrkohle AG Bergbau-Forschung GmbH and the University of Saskatchewan is also presented. Problems of dewatering are briefly mentioned.

56455 Coal washing first in South Africa. *Coal, Gold Base Miner. South. Afr.;* 25: No. 6, 35(Jun 1977).

Fives-Cail Babcock France has been awarded a R4 million-plus contract for a coal washing plant by Tavistock Collieries Limited. The main feature of the installation is the compactness of the 3 Heavy Medium Drewboy washing units.

56456 High speed filter centrifuges for drying coal. Shlau, A.V. *Ugol;* No. 3, 52-55(Mar 1977). (In Russian).

A description is given of high-speed vibration filter centrifuges which provide a single flow and minimal operational arrangement for the technological dessication of fine concentrate during the washing of coal.

56457 Coal concentration tailings as a valuable resource for the production of ceramic wall products. Burmistrov, V.N.; Klimtsov, E.Ya. *Ugol;* No. 3, 58-60(Mar 1977). (In Russian).

Criteria are established for evaluating the suitability of mining wastes for the manufacture of ceramic construction materials. 1 table.

COMBUSTION

REFER ALSO TO CITATION(S) 56331, 56333, 56351, 56907, 56908, 57390, 57391, 57393

56458 (FE—1817-4) Pollutant control through staged combustion of pulverized coal. Technical progress report, January—December 1977. Wendt, J.O.L.; Lee, J.W.; Pershing, D.W. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Feb 1978. Contract EX-76-C-01-1817. 160p. Dep. NTIS, PC A08/MF A01.

Mechanisms governing the fate of fuel nitrogen during pulverized coal combustion are often controlled by events occurring in a fuel rich environment. This is especially true for staged combustion, which, although known to be effective for NO/sub x/ abatement, still requires its optimum configuration to be determined. The tests reported here constitute a major portion of an in-depth investigation of NO/sub x/ formation mechanisms under fuel rich and staged combustion conditions. Time resolved measurements of NO/sub x/, CO, CO_2 and O_2 were obtained in a plane flame 2 kg/h pulverized coal combustor. It was found that at all fuel rich conditions, NO is formed very rapidly and then slowly destroyed, the early peak NO is a strong function of stoichiometric ratio, and consists entirely of fuel NO. Time resolved profiles obtained under staged combustion conditions indicated that "second stage" NO was very important at low first stage stoichiometric ratios, that it consisted of fuel NO, and that, surprisingly, it was independent of first stage residence time. At higher but still fuel rich stoichiometric ratios NO was observed both to be formed and to be destroyed at the staging position. The major limitations to increased NO/sub x/ abatement through classical staging were found to arise from (a) the high initial rate of NO formation, (b) the slow rate of NO reduction, and (c) the formation of second stage NO. An advanced staging concept, described herein, was designed to eliminate these limitations and was successful in achieving a 90% NO reduction.

56459 (HCP/T1237—01/3) Multicell fluidized bed boiler design, construction, and test program. Quarterly progress status report, January—March 1978. (Pope, Evans and Robbins, Inc., New York (USA)). Jul 1978. Contract EX-76-C-01-1237. 76p. (FE—1237-12). Dep. NTIS, PC A05/MF A01.

The objective of the program is to design, construct and test a multicell fluidized-bed boiler as a pollution-free method of burning

high-sulphur coal or burning highly corrosive coals without excessive maintenance problems. The fluidized-bed boiler will provide approximately 300,000 pounds of steam per hour. Steam pressure and temperature conditions were selected to meet requirements of the site at which the boiler is being installed. Laboratory results and plant modifications and improvements are detailed. Engineering studies of several components are described. Materials testing of samples and boiler tubes are reported. Examination of boiler tubes revealed no serious deterioration attributable to the service conditions. (LTN)

56460 (HCP/T2295—01) **Modeling of fluidized bed combustion of coal. Final reports. Executive summary.** (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1978. Contract EX-76-C-01-2295. 34p. Dep. NTIS, PC A03/MF A01.

Based upon state-of-the-art models as building elements, an initial (first order) system model has been developed which can approximately compute (a) carbon loading, (b) combustion efficiency, (c) carbon particle size distribution (d) SO_2 emission, (e) stone utilization, (f) heat transfer coefficient for horizontal and vertical immersed tubes, (g) bed temperature and (h) NO/sub x) emission.

56461 (HCP/T2472—24) **Fluidized bed combustion industrial application demonstration projects. Quarterly technical progress report, January—March 1978.** (Battelle Columbus Labs., OH (USA)). Jul 1978. Contract EX-76-C-01-2472. 22p. Dep. NTIS, PC A02/MF A01.

A subscale experimental unit has been designed and constructed and is being used to develop design information for a 25,000 lb/hr demonstration industrial steam generator using an advanced fluidized-bed combustion process. Nominal design for the subscale unit is a firing rate of 400 lb coal per hour and a bed cross section of approximately 2 square feet. Successful operation of the subscale system has been demonstrated with over-bed firing of as-received stoker coal. A modified ash recycle system successfully recycled hot ash at rates up to 2000 lb/hr. Experimental work is continuing to obtain additional data on carbon and calcium utilization. Examination of erosion protection shields on one boiler tube showed two materials with no sign of degradation after 585 hours of operation.

56462 (HCP/T2488—04) **Evaluation of fluidized bed combustion (FBC) waste for agricultural purposes. Semi-annual progress report January—June, 1978.** (West Virginia Univ., Morgantown (USA)). Aug 1978. Contract EX-76-A-01-2488. 11p. Dep. NTIS, PC A02/MF A01.

An agreement between the United States Department of Agriculture, Science and Education Administration, and the Energy Research and Development Administration provides for an intensive research program to evaluate the spent bed material from fluidized bed combustion for potential usage in agriculture. The work will involve detailed chemical and physical analyses of the material and extensive greenhouse, growth chamber and field studies. The results of experimental crops grown with applications of solid wastes from fluidized-bed combustion, limestone, and other treatments are reported (apples, peaches, pecans, grapes, swiss chard, buckwheat, etc.). Chemical analysis of these crops are compared with crops grown on control fields. The crops are being fed to cattle and sheep. (LTN)

56463 **Fluidized bed combustion for steam raising and power generation.** Finlayson, P.; Ballantyne, J. *Energy Dig. (London) ;* **6**: No. 4, 11-12(Oct 1977).

The advantages of fluidized bed combustion are outlined. This is a shortened version of a paper presented at the Eurochem conference.

56464 **Downjet combustion of solid fuels.** Barowa, A.K.; Sunavala, P.D. *J. Inst. Fuel;* **50**: No. 403, 76-86(Jun 1977).

The downjet combustion of solid fuels, a combustion technique in which all the combustion air is supplied in a jet directed down at the bed of fuel, has been studied. The effects of the main parameters involved in the design and performance of a downjet furnace were investigated and four types of fuel (medium and small charcoal, gas, coke and briquetted coal) were tried. It was found that fuels with friable ash are necessary for this type of combustion.

56465 **Fluidized-bed combustion of coal: status and prospects.** Gordon, J.S. (Mitre Corp., McLean, VA). *Proc. Am. Power Conf.;* **39**: 441-447(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Operation and advantages of fluidized bed combustion systems are discussed. A description of fluidized bed combustion (FBC) is included along with a discussion of the status of atmospheric utility FBC systems and pressurized FBC systems. An assessment of a pilot plant demonstration of a pressurized FBC system is also included. (JRD)

56466 **Correlation of fireside boiler fouling with North Dakota lignite ash characteristics and power plant operating conditions.** Sondreal, E.A. (Energy Research and Development Administration, Grand Forks, ND); Selle, S.J.; Tufte, P.H.; Menze, V.H.; Laning, V.R. *Proc. Am. Power Conf.;* **39**: 448-461(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Studies are reported on ash fouling when burning North Dakota lignites, conducted during the past year by the Grand Forks Energy Research Center (GFERC) in cooperation with electric utilities. It was found that the test probe fouling rate for the cyclone-fired boiler was about one half that of the pulverized coal-fired unit at similar temperatures. This indicates an important advantage for cyclone firing, subject to the qualifications discussed in the text. If the proposed New Source Performance Standard for lignite of 0.6 lb NO/sub x//MM Btu is imposed, no further cyclone-fired boilers will be built. Imposition of the standard at this time suggests a possible risk of greater fouling, lower plant availability, and higher operating cost for future boilers based on the present findings. Sodium is indicated to be the most reliable predictor of ash fouling. The other factors tending to increase fouling were SiO_2, ash, and an increase in boiler load (or gas temperature). The only reported variable acting to decrease fouling was calcium, and the statistical validity of this effect is questionable based on the current data. The level of ash fouling was shown to be predicted with high statistical validity for data sets representing moderate load, but with far less validity for all data representing the total range of load. The validity of the trends observed would, it is believed, be greatly improved by treating a much larger number of data sets. For the data available at this time, the trends which can be identified have been previously established in both field and laboratory tests, and the current work cannot be said to have identified any previously unrecognized effect. The principal limitation of this method of study is that the observed fouling at any one time is not only a function of the operating conditions at that time, but also of all previous fouling since the last boiler cleaning.

56467 **Preparation and burning of solvent-refined coal.** Downs, W. (Babcock and Wilcox Co., Alliance, OH); Wagoner, C.L.; Carr, R.C. *Proc. Am. Power Conf.;* **39**: 467-475(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The solvent refining of coal is one of several approaches currently being evaluated by Government and private sources to produce a relatively clean fuel from coal. Solvent-refined coal (SRC) processes are presently being evaluated on the pilot-plant scale at Wilsonville, Alabama and Tacoma, Washington. This fuel is a low melting point, low ash, low-sulfur solid fuel which is intended to be a substitute for coal. The Babcock and Wilcox Company first evaluated a deashed coal in 1965 for the Office of Coal Research. That product had many of the properties of SRC. In 1974 the company entered into contract with the Electric Power Research Institute (EPRI) to study solvent-refined coal. Initial studies included: laboratory fuel analyses, pulverizing tests in an impact mill, conveying and storage of pulverized and unpulverized solvent-refined coal, and combustion of pulverized solvent-refined coal in a 500-lb/h test furnace. A dual-register burner was selected as having the best chance of any conventional B and W burners for improving combustion efficiency. With EPRI's support, work began in the spring of 1976 to evaluate the adequacy of this burner to combust pulverized solvent-refined coal. The test program involved a comparative evaluation between SRC and a high volatile bituminous coal. Results of the tests are tabulated and analyzed. (JRD)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 56426

56468 **Improving coal quality.** Dobina, A.S.; Belovolov, V.V.; Goncharova, G.M. *Ugol;* No. 3, 55-58(Mar 1977). (In Russian).

Factors influencing the quality of production in the coal industry are examined. 2 tables, 4 references.

56469 **Ukrainian coal industry in 1976.** Frisch, H. *Glueckauf;* **113**: No. 19, 962-963(6 Oct 1977).

Production and other statistics on the Ukrainian coal industry are presented.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 56422, 56423, 56427, 56428, 56435, 56437, 56439

56470 (NTIS/PS—78/0159) **Mine ventilation (a bibliography with abstracts). Report for 1964—Feb 1978.** Hundemann, A.S. (Na-

tional Technical Information Service, Springfield, VA (USA)). Mar 1978. 146p. NTIS PC N01/MF N01.

Air flow, environmental monitoring systems, dust and mine gases measurement and control, and computerized simulation studies of mine ventilation are presented. Most abstracts pertain to coal mine ventilation. (This updated bibliography contains 141 abstracts, 22 of which are new entries to the previous edition.)

56471 Mine climate monitoring equipment. Birenberg, I.E. *Ugol;* **52**: No. 9, 48-51(Sep 1977). (In Russian).

Automatic methane detectors which can be used for centralized control of methane emission or incorporated into an automatic mine ventilation system are described. Apparatus for the automatic monitoring and control of air flow is also considered. (In Russian)

56472 Methane alarm in cap-lamp assembly. *Ugol;* **52**: No. 9, 45(Sep 1977). (In Russian).

Brief details of the equipment are given. (In Russian)

56473 Noise surveys at collieries. Papers presented to the Chief Scientists' technical (20—21 Dec 1977). Jones, K.; Smales, T.E. London; National Coal Board (1977). vp.

Two papers were presented discussing investigations into the implications of applying the Dept. of Employment's code of practice on exposure of employees to noise. Underground surveys were carried out in several collieries. As a result of these surveys, the machines producing 90dBA at lm. or at the operator's ear have been identified, and the resultant noise zones have been defined. The personal noise exposure of the men has also been established in terms of Leg, from which it was found that 13 percent of the total underground manpower at the three collieries was exposed to an Leg in excess of 90dBA on some shifts. It is shown that further work is required on ear protection and that coal faces and road heads present intractable problems when interpreting and attempting to implement the Code of Practice.

56474 Drilling interlevel rescue operations in coal mining in Poland. Kaliski, M. *Zesz. Nauk. Akad. Gorn.-Hutn. Stanislawa Staszica, Gorn.;* No. 80, 15-30(1977). (In Polish).

This paper analyzes rescue drilling operations which have been undertaken in underground workings. Particular attention is paid to the time taken by individual stages of the operation.

PETROLEUM

56475 Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977). 602p. (CONF-7705120—P1). David L. Riley, Executive Manager, Offshore Tech. Conference, 6200 N. Central Expressway, Dallas, TX.

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Papers presented at the conference and incorporated in Volume 1 are concerned with hydrocarbon potentials, geologic hazards, wind and wave forces, earthquakes, environment, remote sensing, blowouts, ocean mining, seismic sources, soil properties, and materials. A separate abstract was prepared for each of sixty-one papers. (JRD)

56476 Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977). 560p. (CONF-7705120—P2). David L. Riley, Offshore Technology Conference, 6200 N. Central Expway, Dallas, TX.

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Papers presented at the conference and incorporated in Volume 2 are concerned with regulations, navigation systems, offshore facilities, marine exploration, piles, oceanographic design, welding, acoustic telemetry and offshore safety. A separate abstract was prepared for each of fifty-seven papers. (JRD)

56477 Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977). 612p. (CONF-7705120—P3). David L. Riley, Offshore Technology Conference, 6200 N. Central Expressway, Dallas, TX.

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Papers presented at the conference and incorporated in Volume 3 are concerned with moorings, plate tectonics, seafloor foundations, hydrodynamic forces, structure dynamics, pipelaying, drilling, exploration techniques, and arctic environmental conditions. A separate abstract was prepared for each of forty-one papers. (JRD)

56478 Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977). 568p. (CONF-7705120—P4). David L. Riley, Offshore Technology Conference, 6200 N. Central Expway, Dallas, TX.

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Papers presented at the conference and incorporated in Volume 4 are concerned with platforms, pipelines, underwater work, exploration, offshore processing, manpower, structures, corrosion, and repair. A separate abstract was prepared for each of twenty papers. (JRD)

RESERVES

REFER ALSO TO CITATION(S) 57065

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 56408, 56505, 57644

56479 Implications of plate tectonics for offshore Gulf of Alaska petroleum exploration. Rogers, J.F. (Atlantic Richfield Co., New York). pp 11-16 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Gulf of Alaska is coincident with a converging plate boundary, along which the Pacific plate underthrusts the North American plate. Evidence of this interaction shows up in deformational pattern of offshore Tertiary strata, as well as the sedimentary record. A broad belt of compressional structures attributable to plate movement can be traced along the continental shelf and slope of the western Gulf of Alaska, parallel to the Aleutian trench. This field cuts diagonally across the continental shelf of the central Gulf of Alaska, splaying into the Fairweather fault system in an area north and west of Yakutat. Structures within this compressional field show evidence of sequential development - from northwest to southeast. Tertiary sediments record a history of southeastern migration of the Aleutian trench, and a tectonic incorporation of early Tertiary oceanic, trench and slope sediments in a late-forming continental shelf, all in response to episodic, but persistent plate convergence. The implications of plate tectonics for exploration is significant. Knowledge about timing of structural growth, and distribution of reservoir and source rocks is vital to an exploration program. Plate tectonics is not an oil finding tool but a unifying concept to which the required interpretations about structure and stratigraphy can be related.

56480 (SAND—78-0679C) **Improved pressure coring system for fluid content measurements.** McFall, A.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780825—10). Dep. NTIS, MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

Portions of document are illegible.

An improved tool for obtaining cores under near in situ conditions for accurate fluid content measurements is described. Applications concern the determination of the saturations of tight gas sands and unfractured shales. In addition, oil reservoirs, both new and those in secondary or tertiary recovery stages, will benefit. Three separate areas of system improvement research are discussed: (1) incorporation of a low-invasion fluid that is stored in the core retriever and is extruded to seal and protect the core; (2) the design of a diamond bit with features to reduce fluid invasion and increase penetration rate, and (3) mechanical changes to allow the taking of larger diameter cores with greater reliability. The system developmental progression, which utilizes laboratory coring tests to confirm design ideas, is also discussed.

56481 Probability methods in oil exploration. Harbaugh, J.W.; Doveton, J.H.; Davis, J.C. New York; John Wiley and Sons (1977). 281p. $18.95.

Despite the widespread realization that oil exploration is a high-risk, probabilistic business, little effort has been expended in developing objective means of estimating the outcomes of exploration plays and prospects. This book describes statistical methods for quantitatively estimating outcome probabilities that involve the systematic and objective use of geological information. These methods range from simple tabulation of outcome frequencies, to the use of advanced mathematical and statistical techniques such as machine contouring, trend-surface analysis, and discriminant-function analysis. These methods can be effectively used with computers to treat large volumes of information, including data derived from hundreds or thousands of wells.

56482 Structure and possible petroleum traps of lower Cook Inlet, Alaska. Fisher, M.A. (Geological Survey, Washington, DC). pp 17-22 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The regional structure of lower Cook Inlet is a large northeast-trending syncline that extends the width of the inlet. The syncline, which involves Mesozoic and Tertiary rocks, is divided into two oppositely-plunging synclines at the latitude of Augustine Island by the Augustine-Seldovia arch. This arch trends east-west, transverse to the axis of the lower Cook Inlet basin, between Augustine Island and the Kenai Peninsula near Seldovia. A number of anticlines have their axes parallel to the basin axis and intersect the arch at oblique angles. Domical structures could be formed where the two structural trends intersect, providing a possible setting for petroleum entrapment. The northeast-trending anticlines also may be structural traps. Seismic data reveal a number of unconformities in the offshore area. In particular, a regional angular unconformity interpreted to separate Mesozoic and Tertiary rocks extends northeastward along the southeast coast of lower Cook Inlet. Truncated strata beneath this unconformity may contain combined structural and stratigraphic traps.

56483 Review of the structures and stratigraphy of oil occurrences in the northern North Sea. Williams, J.J. pp 23-34 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The North Sea oil province, lying offshore Scotland in the United Kingdom, Denmark, and Norway is the most prolific oil basin outside of the Middle East in the free world. Discoveries to date result in estimated proved recoverable reserves in excess of 23 billion bbl of oil and condensate and 60 Tcf of gas. Discoveries made from 1969-74 generally have been appraised, if considered commercial their platforms have been ordered and have either been installed and are producing, or are still under construction. Predicted production from these facilities will be about 4 million B/D by 1982. The first stage of exploratory drilling, the testing of large closed structures, is nearly finished. The more mature state of exploratory drilling, testing of down-structure combination stratigraphic-structural traps and smaller less obvious geologic featues is now in progress. Future exploration will be based on geological and geophysical concepts evolved from information gained from the wells drilled to date. These evolving geologic concepts in conjunction with cash flow from established production, the physical presence of production facilities, and hoped-for future favorable government/industry relations should sustain exploratory drilling on a moderate scale for several years. Future North Sea exploration drilling will be based on complex higher-risk geology, but optimistically new discoveries will continue. Probable recoverable reserve estimates could run to 30 billion bbl of oil and condensate by 1982, but discoveries beyond that time will probably not equal the annual production rate of about 1.4 billion bbl/year and production must decline gradually.

56484 Nile submarine fan: sedimentation, deformation, and oil potential. Summerhayes, C.P. (Woods Hole Oceanographic Institution, MA); Ross, D.A.; Stoffers, P. pp 35-40 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Nile Submarine Fan is one of the largest in the world. Fan sedimentation probably began in the late Pliocene, burying Miocene carbonates and evaporites (Messinian). Salt flow due to sediment loading caused uplift of the fan's eastern flank to from the salt dome-studded Levant platform. The fan's western flank - the Nile Cone - is deformed by minor folding, faulting, and slumping. The modern fan ends at the Mediterranean Ridge, but formerly extended further, as Nile-derived turbidites are found beneath the ridge. Tectonic and salt-flow deformation of the ridge occurs as a response to subduction of the African plate beneath the European plate. Piston cores about 10 m long show that carbonate sediment occurs west of the fan and on the Mediterranean Ridge. Channels on the Nile Cone contain thick, clean, well-sorted, coarse-medium sands. Thick sequences of thinly-bedded muddy turbidites occur between channels. On the Levant Platform are complex mixtures of thin turbidite sequences and carbonate muds, while young channel deposits are lacking. East of the platform in the Cyprus Basin are mainly grey hemipelagic muds. Thin sapropels (with up to 25% organic matter) are common in cores from all over the area. The turbidites also contain substantial organic matter (up to 2%) mostly as plant fragments. Sapropels and turbidites form potential petroleum source beds over the entire fan; channel sands form potential petroleum reservoirs that may be most common on the Nile Cone. Up-dip migration of oil to stratigraphic traps in abandoned channels makes the middle and upper parts (apex) of the Nile Cone of interest as a potential petroleum reserve. Similar traps, as well as structural traps, may occur beneath the Levant Platform.

56485 Sedimentary basins on the Shumagin Shelf, western Gulf of Alaska. Bruns, T.R.; von Huene, R. (Geological Survey, Washington, DC). pp 41-50 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Two previously underscribed structural basins are outlined by offshore geophysical data across the Shumagin continental shelf in the western Gulf of Alaska. The first basin, herein named Shumagin basin, is between the Semidi and Shumagin Islands and is roughly equidimensional, with an area of about 3,800 km^2. It contains an upper section of presumed Cenozoic sediment as much as 2.5 km thick, characterized by reflection horizons that show divergences in dip, local wedge-outs, and broad folds against the flanks of the basin. This section is in turn underlain by what appear to be complexly deformed sedimentary beds of probable late Cretaceous to early Tertiary age. Shumagin basin is therefore a structural depression in older deformed sedimentary rocks that has been filled by a relatively young undeformed sequence. The second basin, herein named Sanak basin, is an elongate fault-bounded basin northeast of Sanak Island with an area of approximately 1,200 km^2. The basin contains sedimentary deposits of presumed Cenozoic age that may be more than 7 km thick and that are broken by probable growth faults indicating deposition contemporaneous with basin subsidence. The northeast and southwest flanks of Sanak basin appear to be underlain by Cretaceous turbidites and early Tertiary intrusive rocks exposed on the nearby outer Shumagin Islands. Anticlinal folding and stratigraphic truncation occurred during basin subsidence. Available data are insufficient to determine if additional basins are present on the Shumagin shelf or to evaluate with certainty the number and size of potential hydrocarbon bearing structures within Shumagin and Sanak basins. However, the data suggest that prospective stratigraphic and structural features are present.

56486 Evaluation of geologic hazards in OCS petroleum lease areas, southern California continental borderland. Field, M.E.; Clarke, S.H. Jr.; Greene, H.G. (Geological Survey, Washington, DC). pp 69-78 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Studies to characterize the tectonic and sedimentary environments of potential petroleum lease areas in the southern California continental borderland are being carried out by the U.S. Geological Survey. Major objectives are to identify and develop an understanding of features and processes that may be hazardous to petroleum exploration and development. Geologic phenomena investigated include faulting, seismicity, sediment erosion, mass movement, and hydrocarbon seepage. Data are collected principally by high resolution (0.2 to 0.8 kJ; 800 to 200 Hz) seismic reflection profiling and sediment sampling with ancillary data from side-scan sonography, underwater television coverage and deep-penetration (120 to 160 kJ; 40 to 125 Hz) single-shannel seismic reflection profiles. Faults classed as active or possibly active are those that reach the sea-floor or displace beds within the Holocene surficial sediment cover (movement within the last 11,000 years). Evidence of recent faulting has been noted in the vicinity of Tanner and Cortes Banks, on the northern Santa Rosa-Cortes Ridge, and on the Santa Monica and San Pedro shelves. Seismicity data corroborates structural evidence of recent movement in the latter three areas. Slumps, sediment gravity flows, and sediment creep have been identified on gentle to moderately steep (3 to 12°) slopes on the mainland shelf and on the flanks of major ridges and banks. The physical properties of these deposits and their potential for remobilization, as well as criteria for the recognition of zones of future mass movement, are under investigation.

56487 Integrated environmental studies, south Texas Outer Continental Shelf: approach, techniques, results. Berryhill, H.L. Jr. (Geological Survey, Washington, DC). pp 239-249 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The environmental studies of the South Texas Outer continental shelf are part of a national program of environmental studies under the sponsorship of the Bureau of Land Management. The general purpose of the studies is to provide a base of environmental data and an understanding of marine processes for use in managing offshore exploration and development. The results of the first year's effort indicate a strong correlation, both geographically and seasonally, between the various aspects of the marine environment. Bio-

logical activity generally is greatest along the shallow waters of the inner shelf where nutrients are introduced by continental runoff. The biological productivity is greatest in the spring when the amount of runoff reaching the ocean is largest. Increased amounts of nutrients at the outer edge of the shelf in the bottom water plus hydrographic characteristics suggest a movement of deeper water onto the outer shelf. Chemically, the region does not differ significantly from other shelf areas in the Gulf of Mexico. Amounts of both trace metals and hydrocarbons are average for shelf ares, and no anomalously large amounts were detected with but one exception. Methane content of the water from mid shelf seaward to the edge of the shelf at mid and near-bottom depths is locally very high and a supersaturated condition is indicated. Geologically, the shelf has undergone seaward tilting or subsidence as a continuing process. The subsidence has been accompanied by extensive faulting, predominantly of the growth type; areally the faulting has migrated basinward through time.

56488 New marine seismic source of the gas exploder type. Reed, D.H.; Hardison, J.E. (Atlantic Richfield Co., New York). pp 433-440 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

This new marine seismic source is a gas exploder of the DINOSEIS class. The principle of cavitation is built upon to obtain an improved acoustic output. Previous sources of this general type were designed to produce a direct compressional pulse while suppressing cavitation. In the new device a contained detonation drives a single plate through the water at high velocity, forming a cavitation bubble. The natural collapse results in a sharp acoustic pulse with several bar-meters peak amplitude. Such a pulse is ideal for seismic surveys. Several sources can be combined in an array for greater penetration. Underwater photographs are displayed to illustrate the mechanism of pulse generation by bubble collapse. Calibrated far-field acoustic signatures are shown. In addition, waveforms from a downhole geophone in a Gulf of Mexico well velocity survey are displayed. A preliminary single channel marine reflection survey is shown.

56489 Marine seismic surveys. Espey, H.R. (Exxon Production Research Co., Houston, TX). pp 197-200 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The frontiers of petroleum exploration are principally in offshore areas where seismic surveys provide the only technical data for prospect evaluation. The marine seismic industry has grown from 15 crews at work in 1960 to 75 crews today. Worldwide expenditures on marine seismic surveys last year totaled $450 million. The average cost per mile of marine seismic data today is the same as it was 9 years ago. New technology has reduced operating costs counteracting inflation. Significant improvements have been made also in data quality and resolution.

56490 500-channel streamer system. Savit, C.H.; Siems, L.E. pp 201-208 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Space age technology makes possible a seismic streamer cable of 500 data channels. Seismic data are converted into floating-point digital format and transmitted down a coaxial cable by microminiature processing units spaced along the cable. A number of ancillary channels are used for status checking, control, and calibration purposes and to transmit data on the depth and orientation of the cable. The 500 channels originate from 50 10-channel modules. All modules are identical and can be freely interchanged without adjustment of circuits or programs. On board the towing ship, command signals may be generated to bypass damaged modules or to change the sampling rate on selected modules.

56491 Improved method for offshore stratigraphic exploration. Lindseth, R.O. pp 209-214 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Synthetic sonic logs, termed Seislogs, can be synthesized from marine seismic reflection data. The results may be considered equivalent to down hole logging with a long spaced sonic tool, but without the need to drill a borehole. Sonic logs derived in this manner usually correlate well to actual borehole sonics. The method provides substantial subsurface geologic information not otherwise available. Results have been useful in determining predicting lithology, in determining the depositional processes which filled a basin, and in the location of the stratigraphic traps which predominate in offshore sedimentary section. Another application is in evaluating reservoirs.

56492 Seismic identities: stratigraphic and hydrocarbon determination. Carey, B. pp 215-224 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The technique described is of utmost importance in stratigraphic interpretation because it measures sonic velocities and densities and their lateral variations. It will work on layers as thin as 40 feet. These changes can be indicative of facies changes or changes in lithology. The relative amplitudes and stacking velocities of seismic data comprise the required input to the method, however, if sonic and density logs from the area are available, this information can be incorporated leading to greater control of the final results. The procedure requires that the shape of the propagating wavelet in the data be known and that it be a symmetric, zero-phase wavelet. The method is automated, and the end product is velocity and density information for a stacked seismic trace which is displayed similar to velocity and density logs. An iterative scheme minimizes the differences between the response of a seismic modeling system and the seismic data, based on matching amplitude ratios of the data. The method can be performed on as many stacked traces in an area as is necessary to achieve the objective of the explorationist. The technique has been applied to marine data from several different geologic provinces. When the results were compared to sonic and density logs in the proximity of the seismic data, the correlations were good.

56493 Discoverable hydrocarbon reserves from the Baltimore Canyon Trough. Pirson, S.J. pp 235-244 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Baltimore Canyon Trough is part of the offshore Atlantic Coast Continental Shelf and is filled with clastic sediments (sand-shales) ranging from Jurassic to Pleistocene in age. This constitutes an environment very propitious to the existence of stratigraphic or sedimentation traps formed by deformation, differential compaction, and igneous intrusions, including possible faulting and reefing. For the purpose of this evaluation, a knowledge of the nature of the entrapment geometry or mechanism is not needed because the interpretation procedure used is based on reliable and existing magnetic maps of the total earth magnetic field as it responds quantitatively to the hydrocarbons in place. The technique for this evaluation is based on magneto-electric interpretation, i.e., on the evaluation of the vertical flux density of electrotelluric currents generated by the oil and gas in place by virtue of their electrochemical reactions with the catalytic clayey particles of the reservoir and country rocks. There are a number of magnetoelectric interpretation methods ranging from the rapid visual scanning procedure, through the spot-check circle integration, the polygon integration, and the computerized grid integration with downward projection to any desired depth and volumetric evaluation of the hydrocarbons in place. In this study, only the visual scanning and the spot-check circle integration methods were used. Altogether, 55 promising areas were outlined and their approximate locations are shown with respect to the East Coast. Their combined discoverable hydrocarbon reserves are 117.1 Tcf of natural gas and 13.9 billion bbl of oil in place.

56494 South Atlantic Ocean transform fault system and related features at the Brazilian Continental Margins. de Rezende, W.M.; de Oliveira Ferradaes, J.; de Castro, P.J.M.; Porto, R. pp 85-92 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

An effort to evaluate the oil potential of the Brazilian Continental Margins is currently under way through a plate tectonic model. The aims of the work are not only to describe the continental margin fundamental rifting tectonic framework and its evolution, but also its thermal history. The basic work correlates the South Atlantic fracture zones with marginal ridges, marginal offsets, marginal transverse structures, and high land regional structures and/or lineaments. These last elements, pre-existing lines of weakness or newly formed structures, are not always at the same transform directions. In general, the thermal subsidence of both the quasioceanic crust and the quasicontinental crust is much greater than that of the continental and the oceanic crusts. In this region the behavior of marginal fracture zones that may reach the adjacent ocean basins induces the formation of coastal basins on the adjacent shelf and continent. These basins or marginal segments are the result of local differential subsidence, possibly controlled by those fractures. On the whole, the Brazilian Continental Margins subsided gradually from the south to the northeast and from the northwest to the northeast. The subject

of this paper concerns the oil potential evaluation of the Atlantic-type margins. As a result of the work done, the following conclusions can be stated: (1) in general, the transform directions intersect the eastern continental margin, where transverse structural features and/or lineaments were identified; but the same does not hold for the northern continental margin, where the pre-existing or newly formed structures are systematically deviated from the transform directions; (2) the geothermal gradients were possibly very high for the rifting phases and systematically lower and lower for the subsequent phases (mio-eugeocline phases).

56495 Forearc stratigraphy and structure. Dickinson, W.R. (Stanford Univ., CA); Seely, D.R. pp 101-106 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Active continental margins and the active flanks of island arcs lie in the forearc regions of arc-trench systems generated by plate consumption. Arc-trench systems are initiated by contractional activation of previously rifted continental margins, by reversal of subduction polarity following arc collisions, and as island arcs within oceanic regions. The varied configurations of shelved, sloped, terraced, and ridged forearcs arise partly from differences in initial geologic setting, but mainly from differences in structural evolution during subduction. Forearc terranes enlarge during subduction through linked tectonic and sedimentary accretion of deformed ocean-floor sediments and igneous oceanic crust, uplifted trench-floor and trench-slope sediments, and the depositional fills of subsiding forearc basins. Trench inner slopes typically are underlain by growing subduction complexes composed of imbricate underthrust packets of ocean-basin, trench-floor, and trench-slope sediments in thrust sheets, isoclines, and melanges. The structure of subduction complexes is governed by the thickness and nature of oceanic layers rafted into the subduction zone, variable thicknesses of trench and slope sediments, and the rate and obliquity of plate convergence. Petroleum prospects in forearc regions typically are limited by complicated structures within the subduction complex, scarcity of good reservoirs in the forearc basin, often immature source beds, and low geothermal gradients except within the arc massif where heat flux is commonly excessive.

56496 Scientific objectives and preliminary results of deep sea drilling project: international phase of ocean drilling. Moore, D.G.; White, S.M. (Scripps Inst. of Oceanography, La Jolla, CA). pp 107-114 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The goals of deep-sea drilling under the International Phase of Ocean Drilling (IPOD) include the further exploration of the ocean basins and their margins by drilling fewer, but deeper holes into the oceanic crust, the sedimentary wedges that border the rifted continents, and the areas where active subduction is occurring. The first part of IPOD has been devoted to deep penetration of the crust of the Mid-Atlantic Ridge, to determine how its properties vary geographically and with age, and to drilling of the continental margin of the eastern North Atlantic in order to reconstruct the earliest stages of rifting and continental separation. The preliminary results of these programs are summarized.

56497 Rapid shoreline erosion and retreat at Icy Bay, Alaska: a staging area for offshore petroleum development. Molnia, B.F. (Geological Survey, Washington, DC). pp 115-126 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Icy Bay is the only sheltered bay near many of the offshore tracts that were leased for petroleum exploration in the April 1976 northern Gulf of Alaska OCS lease sale. It has been selected as a primary onshore staging site for the support of offshore exploration and development. The environment of Icy Bay has many potentially hazardous features. Most significant are the high rates of shoreline erosion and sediment deposition. The glacier that once filled Icy Bay has receded more than 40 km since 1904. A large hooked spit, Point Riou Spit, has developed on the eastern shore of the bay mouth within the limits of the terminal moraine and has grown to a length of 6.6 km. The Gulf of Alaska shoreline on the east side of Icy Bay has been steadily eroded northward by waves and longshore currents. Analysis of ten sets of aerial photographs taken since 1941 indicates that the eastern shoreline has receded as much as 1.3 km in this 35-year period. The western shoreline has also changed similarly. Field observations during 1976 revealed that the eastern section of Point Riou Spit is frequently washed over by storm waves and is filling in the Riou Bay portion of Icy Bay with sediment. At the point where the spit attaches to the Malaspina Foreland, a forest with trees at least 90 years old is being undercut by wave erosion. If pipelines or any onshore staging facilities are to be placed in the areas of Point Riou, Riou Bay, or the Malaspina Foreland, then the dynamic changes in shoreline position must be considered so that man-made structures will not be eroded away or silted in before the completion of development.

56498 Geochemical model for characterization of hydrocarbon gas sources in marine sediments. Bernard, B.; Brooks, J.M.; Sackett, W.M. (Texas A and M Univ., College Station). pp 435-438 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A geochemical model has been developed to distinguish biogenic from petroleum-related gas in marine sediments. Analyses of seep and sediment gases from the Gulf of Mexico indicate that the characteristic composition of petrogenic gas can be altered during migration through sediments and by mixing with biogenic gas. Measurements of carbon isotopic ratios of methane and hydrocarbon ratios generally provide a definitive interpretation of hydrocarbon gas sources. It is suggested that prospecting for reservoired hydrocarbons include coring on or near observed geologic features to first establish the source of existing hydrocarbon gas in a region.

56499 Source rock characterization method for petroleum exploration. Espitalie, J.; Madec, M.; Tissot, B.; Mennig, J.J.; Leplat, P. pp 439-444 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A procedure and apparatus have been developed for rapid source-rock characterization. Pyrolysis of small rock samples is used to determine various types of source rocks, their degree of evolution (immature, oil zone, gas zone), and their petroleum potential. The method can be performed on cores or cuttings either in the laboratory or at a well site (especially aboard offshore drilling vessels), and in this case it can be used to detect oil shows. Generally the procedure uses ground rock, but it is also possible to operate directly with small cuttings without any prior treatment. Aboard the GLOMAR CHALLENGER (LEGS 48 and 50) the apparatus was especially used as a safety tool to reveal rapidly the presence of oil shows.

56500 Offshore basin assessment for oil and gas using geochemical data. Bayliss, G.S.; Martin, S.J.; Cernock, P.J.; Carlisle, C.T.; Odiorne, J.D. pp 445-452 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Basin assessment of oil and gas potential is, in general, based primarily on the volume of sedimentary rocks, the available reservoir, and by direct comparison with known production in similar sedimentary basins. However, this type of assessment is limited since source rock quality, geothermal diagenetic history (eometamorphism) and migration are not usually considered. Using routinely available geochemical data, it is possible to refine the basin assessment concepts and to derive more definitive values of the true oil and gas potential of a given exploration area. This rationale has been used to estimate the resource potential of leased acreage in the local area of the C.O.S.T. B-2 Well, Baltimore Canyon, Offshore Eastern United States.

56501 Seismic, fluorimetric, and chromatographic studies of reservoir leakage. Whelan, T. III; Purvis, D.B.; Hart, G.; Albright, J.L.; Smith, H.F. pp 453-458 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Flurometric and gas chromatographic analyses have been combined with geology to map presumed petroleum leakage of subsurface hydrocarbon accumulations. Shallow gravity cores taken across seismic features in the Gulf of Mexico and analyzed for fluorescence intensity and light hydrocarbon concentration demonstrate either (1) characteristic patterns of high light hydrocarbon and/or aromatic hydrocarbon concentrations or (2) no surface expression of hydrocarbons except for biologically produced methane. In offshore areas where sediment deposition rates are slow and ancient shales crop out geochemical interpretation of surface samples becomes more complex. Rather than leakage from a hydrocarbon reservoir, fluorescent and gas anomalies in these environments may be due to the sampling of ancient shales which have experienced some degree of thermal maturation. Determination of the thermal alteration index (TAI) in samples with high fluorescent and gas content can establish if in situ thermal processes are responsible for the geochemical anomalies. A combination of seismic, geochemical

and geological analyses of offshore surface sediments can yield useful information concerning the presence and type of hydrocarbon accumulations in the subsurface.

56502 Environmental conditions on the Continental Shelf off west Greenland. Nielsen, H.A.; Dietrich, J.; Fabricius, J. pp 533-546 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Petroleum exploration activities started on the Greenland Continental Shelf in 1975 and intensive data collection programs on hydrographic, meteological and ice conditions have been carried out during the summer and fall seasons 1975 and 1976. The environmental conditions in the Davis Strait is described with emphasis on the concession areas between latitudes 63° and 68°N. The wave climate which is strongly correlated with the storm conditions was found to vary with the location and the seasons with the most severe conditions occurring late fall. During 1975-1976 the maximum recorded wave heights was 6.8 m with corresponding wave periods of T/sub z/ = 9.5 s. The currents on the shelf were found to be governed by a general northward circulation of water and tidal current. The tidal currents vary geographically from weak diurnal currents to strong semidiurnal currents. Variations in currents were also found with the depths. Maximum current velocities were in 1975-1976 measured at 80 cm/s and the daily net drift speed was typically 10 to 20 cm/s. The ice conditions are governed by Vestis ice and icebergs of glacial origin. One-meter thick Vestis moves southwards during the fall and covers large parts of the Davis Strait during winter and spring. Icebergs are found in many sizes throughout the year. They originate mainly from the east and south coasts and from the Disco Bay in the north. The maximum size and draught of the measured icebergs were 8.5 million tons and 150 m, respectively.

56503 Shallow structures of the South Texas Continental Shelf. Pawley, J.K. pp 217-226 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Interpretation of a regional high resolution seismic survey of the South Texas Continental Shelf was done at two levels: water bottom and shallow structure. A number of reefs, channels, and direct hydrocarbon indications were mapped and described in relation to the hazards they might present to offshore operations. Examples of records showing such features have been included.

56504 Intense temperature changes in the Hungarian Basin. Shtegena, L. (Univ. Eolvos Lorands, Budapest). *Ann. Univ. Sci. Budapest. Rolando Eotvos Nominatae, Sect. Geol.;* **18**: 115-129(1976). (In Hungarian).

The Pannon basin is a young intermountainous basin (intermountain—interarc, retroarc), covered by Miocene and, primarily, Pliocene sedimentary rock having a total thickness of 3 km and a fine sial crust. The geothermal temperatures are exceptionally high. The average geothermal temperature at a depth of 1 km is 65°C and the average geothermal gradient is 0.55°C/m. A high geothermal level is generally characteristic of the basins—interarc. The geothermal plutonic gradient is $delta^2T/delta^2z = 4.10^{-60}$ C/m² on the average. Subsequently, the average temperature production of sedimentary rock is $6.7.10^{-3}$ m W m^{-3} (16HGU) with an average value (6HGU). Locally, along the line of the fracture, the geothermal temperatures reflect the movement of water directed toward the earth's surface which the compaction of sedimentary rock compresses from the rocks. The amount of water raised by these systems of faults can be determined by detailed measurements of temperature flows. More than 90% of the world's oil zones have a geothermal temperature lower than 11°C, and the temperature of the very hottest oil zones is about 170°C. These facts, in addition to the so-called porphyrin thermometer, have facilitated the preparation of forecasting maps for deep petroleum sites on the basis of geothermal temperatures. The oil zones of the Pannon basin are in the geothermal deep interval in which the diogenesis of montmorillonite--illite in the sandstone occurs. This indicates that the primary migration of petroleum genesis is caused by clay diagenesis. The Pannon basin is a low seismic region with surface shocks of small stellar magnitude. Seismic energy is primarily manifested where the horizontal geothermal gradient is large. This indicates that the horizontal temperature differences effect the shocks so these differences indicate mechanical stress. 15 diagrams, 1 table, 20 references.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 57068

56505 (FE—2025-T1) **Candidate reservoirs for enhanced oil recovery, guidelines for their selection and appraisal of significant tests to date. Final report.** Cronquist, C.; Portugal, D. (Gulf Universities Research Consortium, Houston, TX (USA)). Mar 1977. Contract EX-76-C-01-2025. 369p. (GURC—153). Dep. NTIS, PC A16/MF A01.

Elements which are keys to the effective management of the ERDA Enhanced Oil Recovery Programs are described. Results of efforts to develop screening criteria to identify reservoir rock-fluid characteristics considered suitable for application of EOR processes which appear to have the best chance for commercial recovery of significant additional volumes of oil are summarized. A review of significant field tests made to develop the management matrices is included. Over a hundred published references describing completed and ongoing tests of EOR processes were reviewed to compile the data reported in the four matrices. The knowledge derived from these and subsequent field tests, plus that derived from laboratory research, serves to continually improve the state-of-the-art, thereby reducing the risk in tests yet to come. As the state-of-the-art improves, and as more data comes into the public domain, the matrices should be updated, and the screening criteria should be revised accordingly. An extensive set of data representing 2,420 reservoirs in the United States which have been identified as potential candidates for enhanced oil recovery is included.

56506 (PNL-RAP—25) **Tertiary oil recovery: potential application and constraints.** Geffen, C.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 163p. Dep. NTIS, PC A08/MF A01.

The technology of tertiary oil recovery methods is described and potential economic and environmental constraints to future commercial application are identified. Oil recoverable by tertiary techniques represents a domestic resource of between 11- and 42-billion barrels. Estimates of additional oil supplies from tertiary methods by the year 2000 range from 1 to 8 million barrels per day, depending on the price of oil and the rate of technological development. The principal constraints to large-scale application of tertiary methods at the present time include environmental, economic and technological concerns. Regulatory action associated with the Clean Air Act Amendments of 1977 currently delay the expansion of thermal recovery operations in California and may discourage future projects. The high production costs of tertiary projects also hamper process implementation. Further testing and research is necessary to develop the technology of tertiary recovery methods and prove these techniques successful on a field-wide scale. To enable tertiary oil recovery to play a significant role in augmenting domestic energy supplies, further research and development is necessary. More accurate methods of determining reservoir structure and residual oil saturations are required, as well as means for assuring the technical feasibility and success of a tertiary method in different reservoir types. Technical process limitations must also be resolved. The severity of potential environmental impacts and constraints identified in this report should be determined. These concerns include the air pollutant emissions from steam generation in thermal processes; acceptable methods of brine disposal; damage due to runoff or accidental discharge of oil-rich chemicals into surface waters; the impacts of fluid injection on deep aquifers and the prevailing geological structure; and an adequate supply of high quality fresh water.

56507 (SAN—1556-2) **Coalinga Polymer Demonstration Project. Second annual report, July 1976—July 1977.** Bates, T.; Bowman, R.W.; Fromm, R.E.; Montague, D.R.; Swarbrick, J.C.; Tinker, G.E.; Tixier, C.E.; Zemel, B. (Shell Oil Co., Ventura, CA (USA)). Jul 1977. Contract EF-77-C-03-1556. 186p. Dep. NTIS, PC A09/MF A01.

The Coalinga Polymer Demonstration Project is a jointly funded venture between the Shell Oil Company and the United States Energy Research and Development Administration (ERDA) that was initiated to test polymer flooding as an enhanced oil recovery method in the East Coalinga field of California. The 132-acre project area consists of four 22-acre inverted five-spot injection patterns plus a 44-acre up-dip area (with no injection wells) that will be monitored as part of the evaluation procedure. The Temblor Zone II reservoir being flooded consists of about 125 feet of net pay divided among ten sands with a 350-foot gross interval. In addition to the production and injection wells making up the five-spots, there are four observation wells located within the injection patterns to sample liquids from individual sands and one logging observation well used to determine changes in liquid saturation. Additional oil recovery from the demonstration project is expected to amount to 2,600,000 barrels which includes 600,000 barrels from polymer injection. A water injection phase has been under way for about one year. The lack of a clearcut waterflood response has prolonged this phase. A series of polymer and water injection tests was carried out in a polymer test well outside the injection patterns. The results of the tests were inconclusive and future polymer injection tests are probable. The polymer injection phase is expected to start in January

1978 and continue for approximately 1.5 years, or until it is possible to evaluate the polymer flood performance. After a production monitoring phase of one year, during which a reliable comparison of the performance of polymer flooding and waterflooding will be determined, a proposal would be considered for a full-scale expansion of the optimum supplemental recovery process.

56508 (SAND—78-0652C) **Development of downhole steam generation systems and injection string modifications for deep steam injection.** Fox, R.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 12p. (CONF-780825—4). Dep. NTIS, PC A02/MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

The use of steam injection for reservoirs deeper than 2500 feet becomes unprofitable due to heat losses from the injection string and mechanical failures resulting from the high thermal and mechanical stress required for steam delivery to deep reservoirs. Thus, the application of steam flood techniques to significant numbers of deep reservoirs requires either advancement in key well completion components or development of downhole steam generation devices. A program was initiated in 1978 to develop the technology required for deep steam generation. The activities and plans for improvement of surface injection of steam and for the development of a downhole steam generator are reviewed. Economic surface injection requires reduction in heat loss from the injection string and improvement of other components. Heat loss mechanisms and possible approaches to reducing that loss are examined. Development activities aimed at reducing problems in packers and other components are discussed. A promising alternative to surface generation and injection is to produce the steam in the reservoir using a downhole steam generator. Possible approaches to such a generator are reviewed. Designs currently in development are examined in detail. Problems as formation plugging, gravity override, and combustion at high pressure are reviewed along with the studies in progress to overcome those problems.

56509 (SAND—78-0678C) **Portable high temperature, high pressure viscometer.** Reineke, R.C.; Varnado, S.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 13p. (CONF-780825—6). Dep. DTIS, MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

Portions of document are illegible.

A field instrument for measuring the rheological characteristics of drilling mud at simulated downhole conditions has been developed. The instrument can provide viscosity measurement to 300 centipoise at temperatures up to 500°F, pressures up to 12,500 psi, and shear rates up to 1000 Hz. The design of the system and the results of some preliminary tests on water-based and oil-based drilling muds are described. The design consists of a rotational viscometer packaged inside a heated pressure vessel. The fluid sample is placed inside a test cell and the desired temperatures and pressure conditions are then selected. A direct readout of viscosity is provided. Four samples of water-based muds have been tested; a bentonite mud, a bentonite mud with ferrochrome lignosulfonate (FCL) thinner, a bentonite based mud with FCL and lignite thinners, and mud developed by Maurer Engineering for geothermal use. Tests on these muds indicate that the addition of thinners is effective in increasing the usable temperature range of the bentonite mud from approximately 125 to 200°C. Pressure effects on water-based muds were found to be insignificant. Oil-based muds exhibited thinning characteristics with increasing temperature and a marked increase in viscosity with increased pressure. Therefore, during drilling, the borehole pressure tends to compensate for the thinning effect of borehole temperature. Curves showing this quantitative dependence of viscosity on temperature and pressure are presented.

56510 (UCID—17812) **Environmental impact assessment: enhanced oil recovery by caustic flood, Long Beach, California.** O'Banion, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jun 1978. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

The U.S. Department of Energy (DOE) has contracted with the City of Long Beach to share the cost of a field experiment in oil recovery by caustic waterflood. The contract is 1 of 21 awarded to oil producers by DOE to test various techniques for enhanced oil recovery (EOR). The goal of the EOR program is to develop processes that can be employed in a variety of environments with predictable results, and requisite conditions for wide-scale industrial use. The experimental project is located on one of four man-made islands in Long Beach Harbor, constructed for and devoted exclusively to oil-production activity. No significant environmental impacts are expected from the project.

56511 Process for selectively plugging areas in the vicinity of oil or gas producing wells in order to reduce water penetration. Chauveteau, G.; Moulu, J.C. (to Institut Francais du Petrole). US Patent 4,095,651. 20 Jun 1978. Priority date 25 Sep 1975, France. 6p.

Process for reducing or suppressing water penetration into oil or gas producing wells which comprises injecting an aqueous polymer solution of controlled viscosity into an underground formation and then placing the well on production is described. The polymer is, for example, hydrolyzed polyacrylamide and the solution is preferably a salt solution.

56512 Oil recovery process usable in high temperature formations containing high salinity water which may include high concentrations of polyvalent ions. Tate, J.F.; Maddox, J. Jr. (to Texaco Inc.). US Patent 4,094,798. 13 Jun 1978. Filed date 27 Dec 1976. 12p.

A description is given of a fluid containing a dual surfactant system and a process using the fluid for recovering petroleum from petroleum formations containing high salinity water, e.g. from 50,000 to 225,000 parts per million which may include from about 200 to about 14,000 parts per million polyvalent ions such as calcium and/or magnesium dissolved therein and a method of using said fluid in a surfactant flooding oil recovery process. The surfactant system comprises a water-soluble salt of petroleum sulfonate or an alkyl or alkylaryl sulfonate wherein the alkyl chain may have from 5 to 25 carbon atoms, plus a phosphate ester surfactant with an average molecular weight not to exceed 1000. The surfactant combination is stable up to at least 225°F and resistant to bacterial attack and inhibits scale formation.

56513 Method of assisting the recovery of oil using steam. Gomaa, E.E. (to Chevron Research Co.). US Patent 4,093,027. 6 Jun 1978. Filed date 1 Dec 1976. 6p.

A method is disclosed of improving hydrocarbon recovery from a hydrocarbon-bearing formation utilizing a steam drive from an injection well to a production well wherein the quality of the injected steam is maintained at a value between 35 and 45% to maximize the heat utilization of the steam.

56514 Method for generating horizontal fractures in a wellbore. Godfrey, C.S.; Moore, E.T. Jr. (to Physics International Co.). US Patent 4,091,870. 30 May 1978. Filed date 26 Oct 1976. 4p.

A method is disclosed for generating a horizontal fracture through a wellbore by causing two explosively induced shear waves to intersect. This is achieved by placing, within a coupling fluid within a wellbore, a length of high explosives whose center is adjacent the location where a fracture is desired. Both ends of the high expolosive are ignited simultaneously.

56515 Junction housing for use in undersea oil wells. Hoel, E.; Mathiassen, S. (to A/S Akers Mek. Verketed). US Patent 4,090,560. 23 May 1978. Priority date 27 Aug 1975, Norway. 6p.

A junction housing is described, which is removably positionable on the subsea floor, includes coupling halves for connection to complementary coupling halves of Christmas trees on subsea hydrocarbon wells, the coupling halves being connected by pipes and cables to separate coupling halves which are connectable to complementary coupling halves on a suitable riser.

56516 Casing seal and blowout preventer tester and test method. Dixon, W.P.; Caldwell, T.C.; Ilfrey, W.T. (to Exxon Production Research Co.). US Patent 4,090,395. 23 May 1978. Filed date 28 Mar 1977. 8p.

Method and apparatus are disclosed for testing the pressure integrity of blowout preventers and wellhead casing hanger seals. An annular pressure chamber between the blowout preventer and wellhead casing hanger is formed by closing the blowout preventer on a tubular member having a test plug which seats within and sealingly engages the casing hanger. Pressure sensing means disposed along the length of the tubular member are used to monitor pressure above, below and within the annular chamber. Pressure changes detected by the sensing means are indicative of leakage across the blowout preventer or wellhead casing seal.

56517 Current oil and gas production from North American Upper Cretaceous Chalks. Scholle, P.A. *U.S. Geol. Surv., Circ.;* No. 767, 1-51(1977).

Production of oil and natural gas from North American chalks has increased significantly during the past five years. Chalk reservoirs have been discovered in the Gulf Coast in the Austin Group, Saratoga and Annona Chalks, Ozan Formation, Selma Group, Monroe gas rock, (an informal unit of Navarro age), and other Upper Cretaceous units. In the Western Interior, production has been obtained from the Cretaceous Niobrara and Greenhorn Formations. Significant discoveries of natural gas and gas condensate also have been made in the Upper Cretaceous Wyandot Formation on the Scotian Shelf of eastern Canada. All North American chalk units share a similar depositional and diagenetic history. The diagenetic history of a chalk is critical in determining its reservoir potential. All chalk has a stable composition (low-Mg calcite) and very high primary porosity. With subsequent burial, mechanical and

chemical (solution-transfer) compaction can reduce or completely eliminate pore space. The degree of loss of primary porosity in chalk sections is normally a direct function of the maximum depth to which it has been buried. Pore-water chemistry, pore-fluid pressures, and tectonic stresses also influence rates of cementation. Oil or gas reservoirs of North American chalk fall into three main groups: 1. Areas with thin overburden and significant primary porosity retention. 2. Areas with thicker overburden but considerable fracturing. 3. Areas with thick overburden in which marine pore fluids have been retained.

56518 Wind simulation in model tests with moored offshore tanker terminals. Chislett, M.S. pp 109-117 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Model tests with offshore structures are frequently made in wind, waves and currents. It is, however, difficult to generate a satisfactory model-scale wind field. The possibilities for impressing the model with the desired wind-forces by installing servo-controlled fans on board are considered. Six alternative fan configurations are assessed. Some of the practical problems are discussed.

56519 High-reliability oil-filled cable harness assembly for use on an underwater blow-out preventer system. Miller, W.C. Jr.; Sowers, W.M. pp 347-350 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

To insure high reliability of an electro-hydraulic blowout preventer control system (B.O.P.), it was determined that interconnecting cable harnesses of the pressure-balanced, oil-filled type would offer several advantages over more conventional, elastomeric-jacketed multiconductor cables with molded electrical terminations. Harnesses and connector for low-voltage power, instrumentation, and control circuits were designed, manufactured, and tested for this application. The design philosophy, solutions to design and fabrication problems, and the testing of components and assemblies are described.

56520 Electromechanical cables for BOP control systems: problems and solutions. Kerr, W.L.; Sawin, F. pp 351-356 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The evolution of electromechanical (EM) and electrohydraulic-mechanical (EHM) cables for BOP applications is reviewed. A developmental project is discussed in which these cables are characterized with regard to stretch and other performance criteria, as well as subsequent technical problems and solutions which have occurred during the deployment of a dozen systems since that inception. Both cable and termination technologies are summarized, with emphasis on single wire integrity and fluid filled pressure compensated connectors. The trend toward multiplexed systems is rationalized on the basis of the size, complexity and cost of the bigger cables and connectors.

56521 Newest pumpdown (TFL) completion capabilities. Yonker, J.H.; Arendt, H.P.; Johnston, R.A. pp 371-376 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The latest pumpdown (TFL) completion methods and capabilities are now being used with consistent reliability worldwide including the North Sea, Gulf of Mexico, Borneo, and on land United States. These capabilities allow placing the H-member at well bottom, full alternate multiple zone dual completions, surface selective downhole shifter/locator system, and downhole gaslift and safety systems; all of which are adaptable to subsea manifolds and atmospheric chambers, riser systems, floating platforms and standard platform completions.

56522 Experimental subsea production station. Chateau, G. (Elf Aquitaine, Republic of Gabon); Rauch, P.; Viard, A.; de Cremiers, B.; Falkner, C.B. Jr. pp 77-86 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Elf Aquitaine experimental subsea production station is installed in 200 feet of water offshore in the Republic of Gabon. With the development of this station, Elf Aquitaine is acquiring the capability to develop subsea fields in water depths to 2000 feet. The experimental station is comprised of three major elements: the Grondin production platform, the support vessel Barge Anguille, and the subsea installation. The seafloor installation includes a template, three wellhead assemblies, a remote module and piping manifolds. The staton is installed on the northeast extension of the Grondin field, 1500 meters from the Grondin platform. The station is linked to the platform with production lines and electric cables for remote control. When complete, the station will include three development wells: one vertical well and two deviated wells. The station has two objectives: to produce the oil from the northeast sector of the Grondin field and to include provisions for experimentation designed to prepare Elf Aquitaine for producing oil in deep water. During 1976, the first well was drilled and completed and most of the subsea equipment was installed. In 1977, the other two wells will be drilled and the experimental phase will begin. The experiments will evaluate equipment and procedures for offshore production including well reentry and normal operating and maintenance operations on the station. The experiments will be conducted from a floating barge equipped with advanced systems including saturation diving, optimized derrick, submarine, and a new generation motion compensator. The principal subsea experimental equipment includes pollution control systems, Xmas trees, tubing hangers, structures, a remote control system and automatic connectors for cables and flowlines.

56523 Design of floating concrete platform for deep water oil production. Kure, G.; Hjertas, B. pp 97-108 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A concrete platform design, (Conprod) is described intended for use as floating production platform in hostile areas such as the North Sea, the North Atlantic and the Gulf of Alaska. The Conprod platform is composed of the same structural elements as the Condeep gravity platform.

56524 First Floating Production Facility: Argyll. Hammett, D.S.; Johnson, J.S.; White, J.L. pp 109-122 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The history and 20-month operating experience of the first Floating Production Facility—Argyll Field—North Sea is presented. The field was developed using subsea wells which produce through a production riser and up to a semi-submersible where the produced fluids are treated. The produced oil is shipped back down the riser to a Single Point Mooring System and tanker. Data on the design and operating experience of the subsea wells, flowlines, production riser, semi-submersible, process equipment, SPM, and tanker are reported. The use of known technology to produce offshore fields utilizing Floating Production Facilities (FPF) will be extended to deplete reservoirs more economically than fixed platform development.

56525 Acoustic telemetry: an underwater alternative. Witmer, D.R.; Pearson, R.E. pp 461-466 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

An experimental acoustic investigation program is described conducted during 1976, to determine the most effective and reliable means of communicating at long range in shallow water. An example of the use of such a system would be remote control and monitoring of subsea wellheads. A key feature of this program was the flexibility of system parameter values that was built into the test hardware. This allowed system design tradeoffs to be performed in real time. Additional benefits were the ability to determine the limiting effects of environmental characteristics on system performance. Results included the demonstration of a system based on frequency-shift keying with frequency diversity. This system was shown to be effective in operating under conditions of severe multipath fading and ray bending in depths of 200 to 400 feet at ranges of 2 to 3 nautical miles.

56526 Safe, pollution-free testing of offshore and Arctic wells. Nutter, B.P.; McGill, H.L.; Scott, B.J.; Fry, H.D. pp 507-514 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Well testing offshore and in remote areas such as the Arctic incurs a substantial responsibility to provide complete test results with maximum safety and environmental protection. This paper describes the new developments in a rapidly advancing technology for testing in these high cost operations. Major emphasis is placed on producing good results to allow making correct decisions in these high investment wells. The subject matter reviews important aspects

of both offshore and remote area well testing. Recent new developments included are surface instrumentation which monitors early downhole flow rate for better engineering of the test, safe provisions for wireline and coil tubing operations, testing with limited fluid production, and new downhole pressure actuated tools for high flow production type testing. Accessory equipment for wireline operations and future developments are also included.

56527 Offshore drilling and production noise levels and acoustic communications reliability: field data. Heckman, D.B. pp 553-556 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Acoustic command or remote control systems that are applied in the offshore environment must be capable of successful performance while subjected to high noise and severe multipath. Successful operation implies a very high degree of immunity to falsely interpreting man-made or natural oceanic noise as a command and yet must exhibit a reasonable degree of probability of detection when commands are transmitted. Particular attention must be paid to estimating the characteristics of the environmental noise and the effects of this noise on an acoustic command system. This paper describes acoustic noise surveys and communication reliability tests conducted on and near offshore drilling and production platforms in the Gulf of Mexico in September 1975. The objective of these tests was to measure noise spectrum levels of typical drilling and production operations and to evaluate the new AMF Sea-Link Digital Acoustic Command System (DACS) in such an environment. Test results of a long-term deployment of a DACS underwater unit adjacent to a subsea production system are presented and discussed. This command system has been designed to meet the stringent requirements needed for application in the offshore environment for such applications as acoustic buoy release, valve control, subsea production control, blow out preventor control, etc. The coding techniques employed in the DACS equipment are briefly described. The noise data are presented and compared with other published data. The characteristics of the noise as they affect the performance of various acoustic coding techniques are discussed. A peculiar peaking of the noise spectrum generated by a drillship was observed.

56528 Challenges associated with the design of oil—gas separation systems for North Sea platforms. Penick, D.P.; Thrasher, W.B. pp 241-248 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The conditions encountered in North Sea oil-gas separation facilities design and operations require that the system be both highly selective and extremely flexible within the space and weight limitations of a production platform. To better understand the approaches used by process engineers in attempting to solve these difficult and sometimes conflicting challenges, discussions are presented of the objectives, some of the more significant factors which influence the potential solutions to these objectives, and some of the approaches utilized to meet these challenges.

56529 Installation of a deep water dry subsea completion system. Stone, W.H. (Union Oil Co. of California, Los Angeles). pp 87-96 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A dry subsea well completion system is described which is not the first, but is the initial non-experimental off the shelf installation of a deep water one-atmosphere air, shirt-sleeve-environment, dry-habitat subsea completion. A chronological account is given of this installation from the selection of the dry system to the commencement of actual oil production from the well. The selection of the total production system, the testing at a dry land test site, simulating underwater conditions of the complete system including the platform facilities and the through flowline (TFL) pump down system, the drilling and completion of the actual well, the installation of the wellhead cellar, the flowline connection, the underwater assembly and the start up of the actual production are included.

56530 Study of non-steady-state, centrally-symmetric, liquid filtration in closed, hetereogeneous media. Bagir-Zade, S.N.; Guseinov, G.P.; Kerimov, A.G. *Zh. Prikl. Mekh. Tekh. Fiz.;* No. 3, 98-105(1976). (In Russian).

This study is the concluding stage of investigating the particular features of non-steady-state filtration of a homogeneous liquid (oil) towards a central well with hemispherical penetration into heterogeneous media having two porosities. The hemispherical regions overlap each other and have different parameter values. Exact solutions are found for the lowering of stratum pressure as a function of time and distance, and also for the change in well output with time at a given flow rate or at the penetration pressure in closed heterogeneous media. The effect of media parameters on development of the oil deposit is established by numerical calculations.

PROCESSING

56531 Low pour middle distillates from wide-cut petroleum fractions. Berger, D.; Eng, J. (to Exxon Research and Engineering Co.). US Patent 4,089,775. 16 May 1978. Filed date 27 Dec 1976. 6p.

A process for simultaneously desulfurizing and dewaxing raw, untreated, high sulfur-containing wide-cut petroleum oil fractions to produce desulfurized middle distillate oils of low pour point with a minimum cracking of the raw fraction to gases which comprises contacting the raw fraction with hydrogen and a catalyst comprising a hydrogenating component and faujasite on an amorphous support is described. A particularly preferred catalyst consists of 95 wt % based on total catalyst of NiO/MoO_3 on an amorphous silica/alumina support and 5 wt % of nickel-exchanged faujasite.

56532 Floating process plants: process engineering, product storage, and economic aspects. Backhaus, H.W.; Neugebauer, A.R. pp 249-254 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Employing floating process plants instead of conventional shore-based facilities means shorter completion periods, less infrastructure and harbor problems, exploitation of marginal fields, easier financing, etc. Furthermore associated gas hitherto mostly being flared can be utilized without undue delay, which in turn would improve worldwide the supply of energy and chemical feedstock, in particular for developing countries with sometimes indigenous hydrocarbon reserves. The floating process plants described can be operated autonomously in all calm water areas close to oil and gas discoveries.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 57628, 57629, 57630

56533 Fire protection on the Beryl A platform. Slye, O.M. Jr. pp 525-528 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A fire protection engineering analysis of the principal fire and explosion risks associated with a large North Sea platform is presented. A review is given of principal fire and explosion protection systems including water spray for fire intensity control and exposure protection, water spray with AFFF, Halon 1301 for fire extinguishment or inerting, manual hose reels with dry chemical twinned with AFFF and portable fire extinguishers. Automatic smoke, fire, and gas detection is utilized for early warning of fire and hazardous gas concentration. Fire protection engineering also plays a part in the area classifications for electrical equipment, arrangement of drainage systems, fire proofing of critical structural members and arrangement and determination of process safety valves. The Beryl platform has a number of unique risk factors including facility size, high production rates and platform construction which necessitated careful analysis of risk and application of fire safety systems. Engineered fire protection solutions in the platform design, safe operation of the facility were provided without extensive layout modification with minimum impact on operations.

56534 Probabilistic approach to structural operational safety. Planeix, J.M. pp 539-552 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The aim of this paper is to introduce the notion of operational safety, i.e., the influence of the action of man on the safety of a system. Explicitly or not, this action must be taken into account when designing a structure. For a given operation, man has: (a) to decide whether or not to attempt carrying out, as a result of his judgment of the environmental conditions, and (b) if his decision is to go ahead, to perform it. The decision and the eventual performance of the operation constitutes the action of man, modifying the environmental loads. Both the decision and the performance of the operation involve errors, with respect to the conditions taken for design. These errors combine with the error inherent in any design analysis, due to calculation of environmental forces and modelization of the structure, to form the error in demand. Quality of materials,

building, and maintenance also deviate from the design standards, resulting in an error in capability. The design safety factor, giving an excess of design capability over design demand, must be such that safety is achieved, i.e., that, in operation, capability remains larger than demand, in spite of the influence of all the above mentioned errors, to an acceptably high probability. To carry out illustrative calculations, on a number of systems for marine work, Gaussian distributions are taken for the errors in the factors affecting capability and demand. These calculations show the influence of the various safety parameters on the number of safe operations allowed by the design.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 57093

56535 (AD-A—051131) **Determinants of the demand for residual fuel oil in the US east coast market, 1960—1976.** Cole, R.M. Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Dec 1977. 146p. (AFIT-CI—78-19).

This thesis is a study of the demand for a primary export product of Venezuela which is, as well, an important imported fuel with respect to the East Coast of the U.S. The objectives are: (a) to determine the most likely factors which bear upon the demand for fuel oil on the East Coast; (b) to pose and estimate an econometric model for the demand; and (c) to attempt short-range forecasts with the model. A prior economic study reveals the most likely variables which are then incorporated in two possible models which are thought to reflect the reality of the demand. The best specified models reveal that the essential factors of the demand are: (a) the lagged demand; (b) the price spread between fuel oil and coal; and (c) income per capita. Subsequent forecasts of the demand, given the same historical conditions which are the basis for the model, signal a reduction through 1980. This conclusion is important to Venezuela because of her position as a marginal supplier and certain inflexibility in her hydrocarbon export package. (Author)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 56391, 57569

56536 Analyzer of oil product content in waste water and its metrological certification. Osipov, V.M.; Chel'tsov, A.V.; Lindenbaum, Ya.M.; Luchinskii, V.V.; Grigor'ev, V.D. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 301-305(Aug 1976). (In Russian).

An infrared method is described for determining the content of petroleum products in waste water from petroleum refineries. A functional block diagram is presented for the semiautomatic instrument which is based on an extraction-photometric mode of measurement. An analysis of results is given for metrological certification with various forms of tests. Micro amounts of petroleum-products down to 0.1 to 0.5 mg/liter can be measured. 2 tables, 1 fig., 6 refs.

56537 Design, development, and performance of INDAIR and MARDAIR flares. Wilkins, J.; Witheridge, R.E.; Desty, D.H.; Mason, J.T.M.; Newby, N. pp 123-130 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

To meet the increasingly stringent requirements of safety and environmental pollution control, high technology flare systems have become a necessary part of the process sytem. BP has carried out a research and development program to produce a new generation of flaring equipment and related practices to satisfy these requirements. The INDAIR and MARDAIR flare systems developed from this research are now in operation on both onshore and offshore installations around the world. The use of these new systems has enabled economies to be made in mast heights and boom lengths together with substantial improvements in safety and environmental pollution control.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 57572, 57573, 57575, 57619, 57624, 57628, 57629, 57630, 57651

56538 (AD-A—049711) **Development of a spilled oil recovery separator for use as part of an oil spill removal device. Final report.** Harvey, A.; Mack, W.; Stevenson, R.; Guzdar, A. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Oct 1977. Contract DOT-CG-53272-A. 105p. NTIS PC A06/MF A01.

This report describes the development of an oil-water separator for use with oil spill clean-up equipment. The development is an extension of technology used previously in designing oil-water separation devices for cleaning bilge and ballast discharge waters. A new design was needed to meet the different flow rate, separation performance, head and suction capability, oil type, and oil inlet concentration requirements. A prototype centrifugal, axial flow separator with a nominal fluid throughput of 100 gpm was developed. This report details the design, fabrication, testing and control of the unit.

56539 (AD-A—049794) **Theoretical study to determine the sea state limit for the survival of oil slicks on the ocean. Final report.** Raj, P.P.K. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1977. Contract DOT-CG-61505-A. 275p. (ADL—79299-F). NTIS PC A12/MF A01.

Limiting sea state condition for the globular dispersion of oil slicks on the ocean have been obtained from simple considerations. Models have been derived for determining the conditions under which breaking waves will disperse an oil slick. Two types of dispersions are considered, viz., surface dispersion and globular dispersion within the water column, with emphasis on the latter type of dispersion. The results indicate that a 3 m significant wave height sea state will tend to initiate globular dispersion and that breaking waves of large crest lengths are essential for a surface dispersion to take place. The depth of penetration of globules of oil formed under breaking waves is calculated to be relatively shallow. The large number of assumptions made and their effects on the results are discussed. Several of the unknown physical parameters of importance are identified and recommendations have been made for experimental determination of some of these parameters.

56540 Field studies council oil pollution research unit. Baker, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 17-19 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

The following topics are discussed: oil spill from tanker ship; research programs on biological effects of oil pollution; environmental effects of refinery effluents; toxicity testing of oils and dispersants; and accuracy of field methods. (HLW)

56541 Oil in marine waters. Frey, M.G. pp 227-230 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Oil has been in marine waters for millions of years, entering from marine seeps as migrating oil reached the sedimentary surface. Most of this oil was biodegraded by marine bacteria. The lighter fractions evaporatd and a portion resisted weathering, becoming tar balls or asphalt slabs. More recently, greater volumes of oil have reached the oceans, both as crude and refined products. Nature still cleans up most of what man spills, but special problems occur when large volumes of crude or refined products suddenly are dumped into a coastal environment. The industry has maintained a remarkable record in its offshore exploration and production program, contribution less than $1\frac{1}{2}\%$ of the petroleum in marine waters.

56542 Environmental aspects of drilling muds and cuttings from oil and gas extraction operations in offshore and coastal waters. Monaghan, P.H. (Exxon Production Research Co., Houston, TX); McAuliffe, C.D.; Weiss, F.T. pp 251-260 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Drilling mud and cuttings discharged from more 21,000 wells drilled offshore and in coastal waters of the United States have not caused detectable environmental damage either short-term or long-term. This is the conclusion from a study of reports of underwater observations during actual discharges of mud and cuttings, laboratory biossay results for materials used in drilling muds, and actual well histories and laboratory results used in extimating the concentrations of mud components. Discharged cuttings fall to the bottom and form a circular or elongate pile up to 150 feet in diameter and less than 3 feet high, thinning rapidly to the edges. Both measurements and calculations indicate that mud discharged during normal drilling quickly mixes with sea water and is diluted at least a thousandfold about 300 yards down-current. Divers have observed fish swimming back and forth through the mud and cuttings discharges, have observed organisms working in the cuttings piles, and have found barnacles growing on and in the exit of the discharge pipe. The materials added in greatest amounts to drilling muds are barite (barium sulfate) and ventonite clays. Bioassay data indicate that these solid materals are nontoxic. Any acute toxicity for a

typical mud should be due mainly to the dissolved lignosulfonate thinner. However, rapid dispersion and dilution quickly lower the concentrations (within a few minutes to an hour) below those found to be toxic in bioassay tests conducted for four days without provision for dispersion and dilution. Mud and cuttings discharges apparently have not caused long-lasting effects, as a wide variety of mobile and fixed organisms are found on and under oil producing platforms. In the Gulf of Mexico, 10- to 15-y old cuttings are no longer distinguishable from the normal sediments. Studies in Timbalier Bay (shallow water and a long history of petroleum operations) have documented no adverse effects on marine life of buildup of hydrocarbons metals.

56543 Outer Continental Shelf development in the Santa Barbara Channel: lack of detectable impact on fisheries. Hester, F.J.; Evans, R. pp 261-268 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Sport and commercial fish catch in the Santa Barbara Channel over a 20 year period is examined in an attempt to detect possible changes in catch that might be associated with OCS activity in the area during that same period. Such changes were not found, indicating that the effects of OCS activities were nonexistent, or minor compared with natural changes in the ocean climate or to fishing pressure on the resources themselves.

56544 One-hundred-ton oil recovery vessel for Bantry Bay. Neal, R.W.; Bianchi, R.A.; Marcus, E. pp 269-278 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

As part of a world-wide program to provide complete oil-spill response capabilities to its operating facilities, the Gulf Oil Corporation has acquired a newly developed oil recovery ship for its deep-water oil terminal Bantry Bay, Ireland. Besides requiring a highly effective oil recovery unit, Gulf also required a ship to patrol the waters near Whiddy Island, where the terminal is located, and periodically to patrol the full length of Bantry Bay, a round trip of obout 50 miles. Located on the southwest coast of Ireland, the Bay is exposed to the North Atlantic Ocean, and sea conditions are frequently severe the year round. In winter, rough to high seas (5 to 20 feet in height) are at a maximum, occurring 33 to 67 % of the time. During spring, rough seas are at a minimum, but still occur 18 to 24% of the time. Half-scale oil recovery tests were conducted in Boston Harbor and at EPA's oil spill control test facility. A description of the facility, the procedures used and surface and underwater photography of several of the tests are presented. Seakeeping properties of the ship designed for use in Bantry Bay, Ireland, were investigated using the 5-D Seakeeping Program. The program was run for nine wave spectra which fully covered the range of sea conditions in which the vessel could expect to operate. The vessel christened the Bay Skimmer, is a fully equipped, 68 foot, 100-ton ship designed to patrol at speeds up to nine knots and to recover oil up to three knots.

56545 Use of Landsat data for the detection of marine oil slicks. Deutsch, M. (Geological Survey, Washington, DC); Strong, A.E.; Estes, J.E. pp 311-318 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The capability of Landsat to detect some oil slicks in marine waters has been verified. Reflectance anomalies associated with the slicks have been detected visually on film data, by photo-optical enhancement techniques and by computer processing. Applications of Landsat oil slick data include environmental monitoring of coastal waters and detection of natural seeps such as in the Santa Barbara Channel, which may serve as a worldwide exploration aid.

56546 Modeling of oil spill trajectories using sequential satellite imagery. McLeod, W.R.; Kennedy, J.H.; Hodder, D.T. pp 319-324 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In Gulf of Alaska waters, eddy patterns appear in enhanced LANDSAT imagery and are stable for months. The eddy patterns themselves extend some 50 miles offshore and show surface drift complexity, not predicted by present models. These results lead to alternative ideas of how to predict spill trajectories in a quasi empirical way using satellite data. This detailed level of information is required if spills are to be controlled on a lease block or platform basis.

56547 Natural oil seep detection in marine environments. Eyer, J.A.; Foreman, J.E.; Raney, G.L. pp 325-330 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

One qualitative parameter that oil explorationists have used for onshore exploration has been the presence of natural oil seeps. The presence of seeps in an area has been a favorable, but not a deciding factor on whether or not oil is present in commercial quantities or whether the rocks are of the type from which oil can be produced. The presence of seeps is one of perhaps a hundred parameters that is considered by the explorationist in the search for oil. Successful documentation of natural seeps can strengthen this parameter and will enable an explorationist to decide on which structure might be most prospective. The mission objective of this project was to determine the feasibility of detecting natural hydrocarbon seeps in the marine environment. In hostile environments, such as the Bering Sea, Beaufort Sea, Baffin Bay, Gulf of Alaska, and the North American East Coast (offshore), areas containing seeps could be upgraded providing all other exploration criteria were met. The natural oil seep detection mission was flown by NASA on July 30, 1974. The second mission was flown on Nov. 22, 1974, over the same area in the Gulf of Mexico. A combination of electronic and photographic data gathering systems was used. A template area was selected based on natural seeps that had been documented by a combination of sources including Continental Oil Co., USGS, Texas A and M, and geophysical and geochemical companies conducting surveys in these areas. The best data of the mission were acquired by the KA62 camera using EK 2424 film with the No. 35 filter.

56548 New innovations for fighting blowouts. Lewis, J.B. Jr.; Mabie, G.J.; Harris, J.Z.; Barnett, R.D. pp 331-338 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

On March 24, 1976, Tenneco Oil Company experienced a blowout in the West Cameron 165 Field. West Cameron 165 Well No. 3, a single-well platform installation, was blowing out of control. By April 11, 1976, the casing strings and the platform had subsided beneath the surface of the Gulf of Mexico, leaving a huge gas boil approximately 100 feet in diameter as the only remaining visual evidence of the blowout. During the ensuing events, new methods were employed for utilizing the Hewlett-Packard Quartz Pressure System and side scan sonar equipment to determine if the blowout well was flowing underground and/or beneath the surface of the water. In addition, Tensor Incorporated's Magnetic Gradient Ranging System (MAGRANGE) was utilized to determine the distance and direction from the relief well to the blowout well.

56549 OSAPE Committee overview and accomplishments. Yancy, I.R. pp 455-459 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The purpose of the Standardization of Offshore Safety and Antipollution Equipment (OSAPE) Committee as defined by the API Operating Committee is described. The committee's unprecedented accomplishments within a four year period are discussed along with its current organization and the industry's effort devoted to publishing six documents. The unique aspects of the program are covered including the procedure for obtaining industry's consensus approval. The ongoing efforts for implementing the programs established and the status of the two documents now being prepared are explained, as well as the committee's future efforts.

56550 Chemistry of marine petroleum seeps in relation to exploration and pollution. Kaplan, I.R.; Reed, W.E. pp 425-434 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Natural oil seepage contributes approximately 10% (0.6×10^6 metric tons per year) of the annual input of petroleum hydrocarbons to the marine environment and half of that arises from the continental shelves of the circum-Pacific. Chemical properties of submarine petroleum seeps off the Southern California borderland have been studied in relation to crude oil produced in the same geographic area, the compositional changes due to weathering in the marine environment, and the hydrocarbon and trace-element compositions of the surrounding sea water and adjacent sediments. An investigation was undertaken to determine whether the hydrocarbon compositions of sea water or surface sediments reflect the composition of nearby seepage and can be used to identify previously unknown petroleum sources to resolve problems of pollution and to aid in

exploration. The analytical procedures included identification of saturated hydrocarbons by GC and GC-MS; stable isotopic ratios of sulfur, nitrogen, and carbon on gas and oil, and the ^{13}C distribution for various liquid-solid chromatographic fractions. The content of nitrogen and sulfur, their isotopic ratios, and the ^{13}C distribution of chromatographic fractions, serve to distinguish oils and seeps derived from different formations. Comparison of GC-MS data from a seep and from a crude oil produced nearby show cycloalkane compositional differences attributable to origins, rather than to differences in weathering history. It is felt that highly reliable methods soon will be established for use in the systematic evaluation of the origin and fate of marine hydrocarbons.

56551 Along-shore coherence of winds along the north Alaskan coast for oil spill analysis. Hufford, G.L.; Welsh, J.P.; Lissauer, I.M.; Thompson, B.D. (Coast Guard Research and Development Center, Groton, CT). pp 529-532 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Forecasting the movement and dispersal of spilled oil along the Alaskan North Slope coast requires the description of the wind field(s). From analysis of available data there appears to be three regimes: a western regime (represented by data from Barrow); a central regime (represented by Lonely and Oliktok Point); and an eastern regime (represented by Barter Island). These regimes must be taken into account in the prediction of oil spill movement during normal conditions. During storm conditions (passage of low pressure systems) the entire coast appears to be regionally controlled rather than locally. An existing Coast Guard storm model can be used to predict coastal winds.

56552 Sea ice thickness profiling and under-ice oil entrapment. Kovacs, A. pp 547-554 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Results obtained with a unique dual-antenna impulse radar system used to profile first- and multi-year sea ice near Prudhoe Bay, Alaska, are discussed. A description of the radar system is given along with representative field data. Continuous ice thickness profiles are required for studies related to modeling and understanding the dynamics of the sea ice cover, heat exchange between the ocean and the atmosphere and mass balance of the ice cover. Ice thickness profiles are also required for studies related to the determination of ice load distributions and force analyses, and the subsurface roughness as it pertains to under-ice sound propagation and to the quantity of oil that would be trapped in the undulating bottom relief of first-year and multi-year ice should an oil blowout occur in an ice-covered sea. From the radar impulse travel times obtained with the use of dual antennas, calculations of thickness, electromagnetic impulse velocity and effective dielectric constant of the ice were made. Ice thicknesses determined by direct measurement and those calculated using the radar impulse travel times were found to be in good agreement. Continuous ice thickness profiles obtained with the radar were analyzed to provide representative cross sections of first-year and multi-year sea ice. These cross sections reveal the undulating bottom surface relief of both ice types. Calculations are presented that indicate a significant amount of oil could be trapped within this bottom relief should the oil be released under the ice from a sea-floor oil-production system.

56553 Pipeline failure: a need for improved analyses and site surveys. Demars, K.R. (Univ. of Delaware, Newark); Nacci, V.A.; Wang, W.D. pp 63-70 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Pipeline failure data for the Gulf of Mexico are analyzed. Over 125 failures are considered with information primarily from government sources. Data show that failures have increased significantly from 7 in 1969 to over 40 in 1975. Fortunately, contamination levels are actually decreasing on a per failure basis because of pollution safety equipment and regional air reconnaissance. Pipeline failures are divided into four categories for analyses purposes including: (1) corrosion and normal wear, (2) abrasion and fatigue, (3) construction-related mishaps, and (4) sediment movement. Sediment instabilities may be directly or indirectly related to three of the four failure categories. The data show a need for detailed site surveys and stability analyses to improve pipeline performance. Additional improvements will come from the use of pipeline corridors in heavily developed areas but detailed feasibility studies will be needed prior to implementation.

56554 Incidence and treatment of oil pollution in oil ports. Dudley, G. pp 27-40 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

The following topics are discussed; frequency of pollutions from oil spills; Milford Haven oil spill statistics; causes of oil pollution; design features of tankers; design features of terminals; treatment of oil pollutions; use of dispersant chemicals; problems of physical removal; and the need for planning. (HLW)

56555 Ecological changes in Milford Haven during its history as an oil port. Baker, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 55-66 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

The current ecological state of Milford Haven, after fifteen years of industrialisation, is described. There are still no overall changes which can be attributed to the oil industry, though a varying pattern of short-term localised effects persists. The most severe of such effects over about one mile of shore are a result of the Dona Marika petrol spillage of 1973. Localised chronic effects in Little Wick Bay are associated with a refinery effluent, and the death of a patch of Spartina (cord-grass) marsh at Martinshaven may also be a result of chronic pollution. Attention is drawn to the problem of unidentifed slicks outside the mouth of the Haven.

56556 Applicability of the Milford Haven experience for new oil terminals. Dicks, B. (Oil Pollution Research Unit, Pembroke, Wales). pp 67-87 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Over the last decade, Milford Haven has expanded rapidly as an oil port. Biological surveys during this period have shown that the oil industry has caused little overall change in the life on the shores of the Haven, though localised damage has been caused by occasional large spillages or in the immediate vicinity of refinery effluent outfalls. As little damage has been done to the marine fauna and flora of Milford Haven, there is a tendency to assume that similar development elsewhere will have little ecological effect. This is not necessarily the case, as certain special characteristics of Milford Haven have aided in keeping it clean. To illustrate some of these special characteristis, and some of the differences between Milford Haven and other development sites, a brief comparison is made of Milford Haven with two other potential development areas: Sullom Voe in the Shetlands, and the Cromarty Firth in the east coast of Scotland. It is concluded that a number of coincidental factors have contributed toward keeping Milford Haven clean. If these factors are duplicated at new sites, or fully understood and taken into account, then a wide range of experience, both in terms of port management and the effects of oil industry development on shore life, become applicable to new development areas. If this is not the case, extrapolation of the Milford Haven experience to new oil terminals can only be regarded as dangerous.

56557 Effect of Kuwait crude oil and the dispersant BP 1100X on the lugworm, Arenicola marina L. Levell, D. (Oil Pollution Research Unit, Pembroke, Wales). pp 131-188 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

This paper describes field experiments on Arenicola marina L. carried out at Sandyhaven Pill, a small estuary on the northern shore of Milford Haven. The height of the experimental plots above Chart Datum, Milford Haven, varies between 4.5 m and 5 m. The plots are covered at high water for periods of between approximately 3.5 h on neap tides to approximately 5 h on spring tides. Kuwait Crude Oil, BP 1100X dispersant, and 1 : 1 and 5 : 1 mixtures, by volume, were used as pollutants. Arenicola densities were estimated by counting casts. The relationship of cast numbers to animal number was determined as 1 : 1, although operator efficiency at finding animals in the excavated substrate was found to be a major variant. Single spillages were simulated by spraying pollutants over Arenicola beds at the rate of 0.2 litre/m^2. A single spillage caused a 25 to 50% reduction in population density. Repeated spillages at two monthly intervals, varying in number from one to six, were carried out. Successive spillages caused progressive reduction of the Arenicola density. Four successive spillages resulted in eradication of the original population of 20 to 25/0.25 m^2. Preliminary experiments to determine the influence of surface water and heavy rainfall on the extent of the effect of the pollutant were carried out.

56558 Refinery effluent sources, constituents and treatments. Roberts, W.G. pp 191-200 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

This paper provides an introduction to the problems of pollution arising at oil refineries, with the main emphasis on effluent water. The major sources of effluent water are described, with an indication of the pollutants which are likely to occur. The treatments available and appropriate for removal of pollutants are briefly described, with comments on their effectiveness and limitations, results which can be achieved with present technology, and an approach to the setting of consent levels. Air pollution and solid waste disposal are mentioned briefly, insofar as direct or indirect effects on the ecology of water resources may arise.

56559 Investigation of refinery effluent effects through field surveys. Baker, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 201-225 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

This paper describes a number of surveys carried out in refinery effluent discharge areas in order to find the species and areas affected. Effluent constituents and volumes vary, and discharge areas range from rocky shores to freshwater swamps. It is possible, however, to classify effluents according to their ecological effects, and the effluent dispersal characteristics form the best basis for such a classification. Well dispersed offshore discharges from modern refineries may not cause any measurable biological changes; in contrast, badly dispersed discharges, for example in mud flat or saltmarsh areas, may greatly reduce the numbers and abundance of species near the effluent. Both salt and freshwater marsh vegetation are capable, however, of surviving at least some chronic oil pollution, and the deliberate management of such communities as a final stage in effluent treatment is an interesting possibility.

56560 Effects of refinery effluents: the case history of a saltmarsh. Dicks, B. (Oil Pollution Research Unit, Pembroke, Wales). pp 227-245 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

A Spartina saltmarsh in Southampton Water, which has had a refinery effluent discharged through its creek system since 1951, was surveyed biologically in 1969 and 1970 to assess the extent of ecological damage. The saltmarsh has been re-surveyed twice a year since 1972 to monitor any changes in the distribution of plant species in association with an effluent improvement programme started by the refinery. The results of these surveys are presented and discussed. A limited amount of information is available on the condition of the saltmarsh from 1950 up to the start of the recent series of surveys. This information and the monitoring programme results provide a picture of, firstly, severe ecological damage to an area of saltmarsh vegetation resulting in bare mud, followed recently by recolonisation of some parts of this previously denuded area by most of the common saltmarsh species. Though recolonisation appears to be associated with the improvement in effluent quality, the recent mild winters, early springs and late autums and the virtual absence of acute oiling incidents since 1970 may also have considered influenced the growth of vegetation. For these reasons, the interim nature of these investigations has been stressed. If recovery continues, the sequence in which the plants are recolonising the denuded areas could result in a saltmarsh dominated by species other than Spartina anglica.

56561 Experimental investigation of refinery effluents. Baker, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 247-254 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

A number of different types of experiment used for the investigation of refinery effluents are described with examples. On the one hand are settlement plate and transplant experiments useful for monitoring and the further study of effects observed during field surveys; on the other hand are laboratory tests for the toxicity ranking of effluents or effluent constituents. The latter type are useful for control purposes and for finding why effluents are toxic. It is difficult to arrange realistic field experments useful for making predictions about the ecological effects of new effluents in new communities, so monitoring is particularly important in such cases.

56562 Some physical and biological effects of oil films floating on water. Van Gelder-Ottway, S. pp 255-277 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

This paper describes investigations made on some physical and biological effects of oil films floating on water, with special reference to the rock-pool environment. Experiments with simulated rock pools demonstrate that photosynthesis and animal activity may be reduced, oxygen levels decreased and temperature increased if oil films are present. Experimental plants and animals generally survived during the period of the experiments and later recovered in clean sea water. From a discussion of the literature, it appears that oil films on water do allow some degree of gas exchange, although the rate of exchange may be complicated by oxygen uptake in the oil in the process of abiotic or microbial oxidation. Effects on rate of exchange are minimal or non-measurable on the open sea and maximal in still water such as rock pools or under various experimental conditions. Temperature and light-reduction effects follow a similar pattern.

56563 Offshore biological monitoring. Dicks, B. (Oil Pollution Research Unit, Pembroke, Wales). pp 325-440 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Little is known of the impact of oil developments on the offshore environment, though there are now a considerable number of these developments around the British Isles. At a more basic level, knowledge of the offshore biological communities of both the North Sea and the Celtic Sea is either limited or nonexistent. This situation should be, and can be, rectified by establishing suitable offshore monitoring programmes. The selection of suitable organisms for a monitoring programme, and the requirements and special problems of offshore monitoring design, are discussed. The aims of the programme should be carefully determined and will influence, in particular, the degree of quantification of sampling and levels of change which can be detected. Data from a baseline survey in a North Sea oil field are used to illustrate problems of monitoring and the treatment of results. The importance of sample number to the quantification of data, and the use of diversity measurements, are illustrated and discussed. There is a need for quantified data for future environmental decision-making offshore. However, the present lack of knowledge of the offshore environment suggests that such detail should be balanced by wide-ranging simple surveys capable of picking up, at the least, gross biological change.

56564 Oil spill in the Straits of Magellan. Baker, J.M.; Campodonico, I.; Guzman, L.; Texera, J.J.; Texera, B.; Venegas, C.; Sanhueza, A. pp 441-471 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

On 9 August 1974 the Metula grounded at Satellite Patch in the eastern Straits of Magellan, Chile. About 47,000 tons of light Arabian crude oil and 3000 to 4000 tons of Bunker "C" are estimated to have been lost between this date and the successful flotation on 25 September. As a result of the spill, large volumes of "chocolate mousse" were produced, and most of this landed on Tierra del Fuego beaches between Punta Piedra and Punta Anegada. Calculations based upon measurements made by the Chilean Marines indicate that a little over 45000 m^3 of mousse landed on this 77 km stretch of shore. An undetermined amount of mousse also landed on some beaches of the mainland and at other localities on Tierra del Fuego. Estimates of the volume of oil contained in this mousse, and of the proportions of the spilt oil that evaporated, dispersed, dissolved or absorbed on to sediments, vary, and there are insufficient data for accurate calculations. The affected shores were relatively poor in macroflora and macrofauna, especially from the mid-intertidal zone to the supralittoral zone. However, towards the sublittoral zone there is a much richer flora and fauna and there some mussel beds and algae were contaminated. The main bird species affected were cormorants and the Magellan penguin. 1500 to 2000 individuals are estimated to have been killed up to the beginning of October 1974; since that time there is evidence of continued oiling and the February 1975 estimate is a total of 3000 to 4000 individuals killed. It does not seem likely, however, that the losses will have a serious effect on the total populations of these species.

56565 Oil spills from tankers. Smith, J.W. pp 473-481 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Although the computer program has only been running for a short time, and the number of returns entered has been far less than was hoped for, nevertheless it appears that the method of analysis will soon produce valuable results which can be used either to modify practices existing on tankers or even to enable equipment modifications to be made, all with a view to reducing the number of accidental spillages. The perhaps more serious accidents which occur while the tanker is in motion and which result from collisions or groundings can ony be dealt with by more traditional maritime methods: improvements in crew training, in navigational equipment

both carried by the ship and on shore, and in some areas by the enforcement of routing and traffic control at harbour entrances, etc. All these matters are, of course, being dealt with by the IMCO Maritime Safety Committee.

56566 Review of world oil spillages. Van Gelder-Ottway, S.; Knight, M. pp 483-520 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

During the course of examining the reports of oil spillages in recent years, it was found to be useful to compile a list of the major spillages, together with basic details of these incidents and any subsequent biological effects. This information is presented in a tabulated form on the following pages. The apparent preponderance of oil pollution incidents in more recent years is partly a reflection of both an increasng total annual quantity of oil handled, and also the ever-increasing size of oil tankers. A more significant reason for the apparent preponderance of oil pollution incidents since 1967, however, is the increasing awareness of potential biological damage of these spillages since the Torrey Canyon disaster which occurred in the spring of that year. Subsequent oil spillages received far more attention from biologists, oceanographers and also the general public, with the result of far greater coverage of these incidents in scientific journals, information-relaying organisations and all news media. A great number of important oil pollution incidents almost certainly occurred in the early and mid-1960s, but reports of these are infrequent in the literature, thus accounting for the relatively small number of spillages during this period described in tables.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 57067, 57093, 57094, 57436

56567 Verification of offshore platform design and installation: the Marine Board panel view. Gerwick, B. pp 7-14 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

At the request of the USGS, the Marine Board appointed a panel to determine whether or not independent third party verification of offshore structures would be of sufficient benefit to the federal government, industry, and the public to warrant the time and costs involved. If the answer was yes, then the panel was asked to recommend the scope and detail for verification, the availability of suitable criteria and guidelines, and the relative merits of alternative organizational concepts for verification. The panel concluded that while the safety record of offshore structures has been excellent, an increased and formalized verification system should be undertaken in order to provide the government with a sound basis for assuring the public of the integrity of OCS structures, especially as they are extended to new frontier areas. The panel emphasized that a proper verification program should be designed to minimize cost and delays and that there should be a transition period during which the third-party verification was transferred from the present procedure to a fully independent set of verification agents. Existing criteria and guidelines are adequate for the present, but an on-going R and D effort by both industry and government should be encouraged. The panel then concluded that no existing verification system or organization was adequate. It recommended a verification system consisting of systems management, promulgation of environmental criteria, establishment of design procedures and rules, and implementation (review and inspection) by independent agents. Under this system, the owner/operator would submit a verification plan in accordance with USGS outlines. This plan would specify the proposed environmental criteria and design rules, and nominate a verification agent. If approved, the plan would then be implemented. Upon completion, the USGS would issue a permit to operate. A step-by-step implementation is envisaged.

56568 Verification of platform design and installation: a contractor's view. Lee, G.C. pp 15-19 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Proposed regulations currently under consideration for all fixed platforms installed in U.S. waters will require that the design be reviewed and that the construction be inspected by an independent third party. The effects these proposed new regulations would have on current design and construction practices are discussed. Even an efficient verification program will undoubtedly increase engineering and construction costs and cause delays in schedule. However, there will be some offsetting advantages. The designer would have a uniform design criteria and basis of design to apply to all platforms instead of a different requirement for each operator. Also, construction should be simplified slightly if all platforms were fabricated by the same specifications. Based on past experience with verification programs in other areas, the proposed verification program cannot be justified by benefit to the designer or contractor.

56569 Platform verification: a view from a member of industry. Brannon, H.R. (Exxon Production Research Co., Houston, TX). pp 21-32 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Concerns have been raised in many sectors regarding the safety and reliability of offshore platforms. The history of offshore operations and technology development is reviewed to demonstrate the level of platform safety achieved by industry operating under a self-verification program. Key differences between self-verification and mandatory, independent third-party verification systems are identified. The impact of third-party verification on offshore development projects, particularly in the area of design, review, and inspection practices, is discussed. It is suggested that self-verification by industry will be more effective than a third-party verification system in meeting industry's and the nation's needs for offshore development with a prudent level of platform safety.

56570 Development and application of Coast Guard regulations for mobile offshore drilling units. Cronk, P.J.; Bishop, K.F. (Coast Guard, Washington, DC). pp 423-430 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The U. S. Coast Guard's intentions to provide regulations for bottom bearing mobile drilling and workover units together with the drilling industry's desire for the uniformity of international regulatory controls of mobile drilling units based on relevant standards led to the development of Subchapter IA (46 CFR 107-109) "Rules and Regulations for Mobile Offshore Drilling Units." The U. S. Coast Guard and the National Offshore Operations Industry Advisory Committee combined resources to develop the proposed regulations which would reflect the industry's need for safety guidelines. The combined Coast Guard-industry expertise capitalizing on 28 years offshore experience analyzed operating procedures, industrial functions, hull designs, the industrial-marine interface, good marine and industry practices, industrial standards and the marine engineering, electrical and industrial systems in order to formulate reasonable regulations. The traditional format of Subchapter IA was simplified by organizing the proposals into three basic parts to facilitate the inspection, design and operational aspects of a unit. Machinery and electrical regulations were amended to provide for differences in design and operation from conventional vessels and to incorporate an industrial systems approach to regulation. The rationale behind the more significant regulation developments is discussed along with viewpoints on their intended application to mobile offshore drilling units.

56571 Application of regulations and design codes for offshore installations. Eri, J.; Ball, D.L.; Middleton, E.M. pp 431-440 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

As offshore activities are moving into areas of more hostile environmental conditions the safety requirements have become more rigid. Industry and authorities are cooperating on developing and improving regulations and design codes. The Classification Societies are heavily involved in this work. This paper gives a brief survey of European Regulations and Codes in use today with special emphasis on applications in the North Sea area. Based upon the experience obtained through certification and control of some 50 steel platforms, 14 concrete production platforms and several pipelines, an evaluation of existing Regulations and Codes is given. Needs for future work in this field are stressed and proposals for further development are presented. Areas where closer investigations and research are needed are proposed.

56572 Norwegian regulations for design of offshore structures. Holand, I. (Norwegian Inst. of Tech., Trondheim). pp 449-453 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

"Regulations for the structural design of fixed structures on the Norwegian Continental Shelf," issued by the Norwegian Petroleum Directorate, enter into force in the beginning of 1977. The regulations as such relate to general safety requirements, also more specific rules for soil investigation and foundation design, and for

concrete, steel and aluminum structures are given. The contents of the regulations are outlined and some points that are considered to be of particular interest are emphasized.

56573 Offshore platform verification program. Krahl, R.B. pp 545-548 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

As oil and gas production is initiated in frontier areas of the Outer Continental Shelf, new offshore platform designs are being proposed to contend with more hostile surface and seafloor environments. A program is being implemented by the U.S. Geological Survey to verify the adequacy of these structures. This program was formulated by the U.S. Geological Survey with the assistance and guidance from a Panel on Platform Verification under the aegis of the Marine Board of the National Research Council and supplemented by a contracted study conducted by The Aerospace Corporation. This program is intended to assure that reasonable consideration of the more hostile environments has been taken into account in the design, construction, and installation of OCS production facilities. The program will guard against unnecessary delays in platform design and construction. It could reduce offshore facility costs through increased knowledge of environmental forces and early detection of possible design oversights.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 57442

56574 Six years experience with the Grega single anchor leg mooring. Synodis, S.T.; Flory, J.F. (Exxon Research and Engineering Co., Linden, NJ). pp 135-140 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The first SALM (Single Anchor Leg Mooring) was installed at Brega, Libya, in October, 1969. During the next six years over 229 million barrels of crude oil were loaded through the facility. In October, 1975 all components of the SALM, with the exception of the base, were removed and brought ashore for inspection, maintenance, and reinstallation. This was the first detailed inspection and maintenance of most of the components. Experience gained during the first six years of operation of the Brega SALM is reviewed. Several modifications were made to improve performance during previous partial inspection and maintenance actions and during the major inspection and maintenance of October 1975. The eye-to-eye connection between the anchor chain and the buoy was replaced in 1972 because of excessive wear. Changes have been made in the underwater hose system to improve reliability. The overall performance of the Brega SALM has been remarkably good considering its prototype nature. The findings of the first major inspection and maintenance of a SALM are described. The buoy and riser only required repainting. Some hose which had been in service for six years was in need of replacement. Although most underwater swivels were still serviceable, two swivels had developed minor leaks during the last year of operation. The universal joints were found to be in good condition.

56575 New concept for single point mooring offshore terminals. Di Tella, V.; Campanile, A.; Paruzzolo, A. pp 141-158 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A new type of offshore tanker terminal and the related specially developed method of analysis of its dynamic behavior are described. The system, called articulated leg mooring system (ARLEMS) is an improved single point mooring buoy capable of mooring large tankers and of withstanding severe meteorological-oceanographic conditions. It is essentially formed of an upper structure supporting the rotating table, connected to a basement standing on the sea bottom, by three tubular legs. Two cardan joints at the ends of each leg allow the upper structure to move horizontally. The advantages of such a system, as well as those of the particular kinematics, are examined in detail. The important role played by cardan joints is pointed out. The method of analysis of the dynamic behavior of the buoy is based on the non-linear motion equations of the legs, taking into account the influence of the different forces and the particular kinematics of the system. A computer program solving non-linear equations by a step-by-step integration technique has been developed; movements of the buoy, as well as loads on the bow hawser, on the legs and on the joints, are evaluated for two typical water depths.

56576 World's largest single point mooring terminals: design and construction of the SALM system for 750,000 DWT tankers. Gruy, R.H.; Kiely, W.L. pp 159-168 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The design, fabrication and installation of two (2) identical Single Anchor Leg Mooring (SALM) Terminals which serve as crude oil export terminals are discussed. Both are designed to safely moor and load tankers as large as 750,000 DWT in environmental conditions that will be occasionally severe. The determination of mooring forces via calculation and model tests and the design and fabrication of the components which transfer these loads are discussed. Of particular interest is the design and fabrication of the heart of the systems, the fluid swivel assemblies which include several innovative features with respect to operation and maintenance. These fluid swivels are the largest ever built for SPM applications and are designed to transfer crude oil and bunker fuel oil simultaneously and to preclude the possibility of commingling of the two fluids. Model tests that were conducted on the fluid swivel/loading hose system will be discussed. The foundation design and the optimization of this design with respect to available offshore construction equipment are outlined along with the installation methods employed.

56577 Design of single point moorings. Flory, J.F.; Poranski, P.F. (Exxon Research and Engineering Co., Linden, NJ). pp 169-176 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Single point moorings (SPMs) are now being designed for deepwater ports off the coasts of the United States, and other SPMs are being designed for deeper depths and more severe environments such as the North Sea. Aspects of designing an SPM are discussed including: what parameters must be considered, how mooring loads vary with key parameters, how model tests should be conducted and their results analyzed to determine mooring loads, what factors determine limiting loads and environments, and what criteria should be observed in mooring system design. The SPM designer must consider all pertinent design parameters including the site, environment, tankers which will be moored, and operating parameters of the mooring. Computer simulation and analytical techniques are now used for design studies and to predict design loads. However, model testing is still usually used to establish final design loads and to verify designs. The maximum mooring loads measured in a single model test are not sufficient to establish realistic design loads; therefore statistical methods are applied. The designer can now refer to recognized standards when designing the SPM structure. High-strength SPM components, such as chains and synthetic ropes, are now available. The capacities of mooring equipment on the vessels to be moored may impose limitations on loads and environments unless the SPM will serve only a few specially modified vessels.

56578 Buoyant towers for Phase 1 development of Garoupa field. Burns, G.E. (Chicago Bridge and Iron Co.); D'Amorim, G.C. pp 177-184 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Phase I development of the Garoupa field, offshore Brazil, employs a new concept conceived by a task force within Petrobras (National oil company of Brazil). Two articulated buoyant steel towers play an important role in the concept, providing mooring facilities and housing flow lines and control lines from subsea equipment to surface facilities. The concept consists of subsea completions, a submarine manifold center, and production facilities aboard a permanently moored 54000 DWT process tanker. The system is made economically attractive by eliminating the need for a fixed drilling and production platform. The process tanker is moored to the larger buoyant tower by means of a structural yoke. The second buoyant tower, located 6/10 mile from the process tower, serves as a loadout facility for transport tankers. The overall system is described along with the development, design, and construction of the two articulated buoyant steel towers.

56579 Experimental prediction of low-frequency oscillations of moored offshore structures. Naess, A.; Boerresen, K. pp 7-18 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The effect of different methods of simulating an irregular seaway has on the ability to predict second order behavior of moored offshore structures by model tests is discussed. A theoretical discussion of the problem is given. This is followed by the experi-

mental results obtained from model tests of an offshore platform subjected to different simulated irregular seaways. These were produced by the two main methods of simulation applied today. One is to superimpose a finite number of regular wave trains. The other consists in filtering white noise so as to obtain a time series with the correct spectral shape, usually in the form of an electric signal, which is then used to guide a wave maker. The conclusion to be drawn from the obtained results is that the second method of simulating an irregular seaway gives us the most reliable estimate of the second order behavior of moored offshore structures.

56580 In-line and transverse forces on cylinders near a wall in oscillatory flow at high Reynolds numbers. Sarpkaya, T. (Naval Postgraduate School, Monterey, CA). pp 161-174 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The in-line and transverse forces acting on circular cylinders placed near a plane boundary in a sinusoidally oscillating fluid in a U-shaped vertical water tunnel have been measured. The drag and inertia coefficients for the in-line force have been determined through the use of the Morison's equation. The transverse force has been expressed in terms of a single lift coefficient. The results have shown that the effect of wall-proximity is to increase the force coefficients for relative gaps of e/D less than about 0.5. In this range of e/D values ($0 < e/D < 0.5$) the non-linear interaction between the shear layers emanating from the top and bottom of the cylinder is reduced and the frequency of oscillations in the shear layers is asychronized. For e/D larger than about 0.5, the regular vortex shedding resumes, more or less unimpeded by the presence of the wall, and the lift, drag and inertia coefficients nearly assume their free-cylinder values.

56581 Downtime simulation analysis for pipelay units. Springett, C.N.; Abramovich, D. (Sante Fe Engineering and Construction, NM). pp 269-276 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Current state of the art for predicting downtime for offshore equipment is briefly reviewed and a new method for calculating downtime, using a Markov chain probability model to simulate all known operational and weather constraints, is described. The results of this method, applied to Santa Fe Engineering and Construction's Choctaw II pipelaying barge, are compared with actual downtime experienced during one working season in the North Sea.

56582 Integrated process computer control system for lay barge operations. Miyake, T.; Kurata, S.; Hori, T.; Sekita, K. pp 277-284 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The most important requirement in lay barge operations is that pipe be laid rapidly without damage. This makes it necessary to effectively organize all information and efficiently present it to the barge operator both in easy-to-understand form and on a real-time basis. Moreover, it is not easy to maneuver a lay barge by operating a number of winches because loads can be allocated to the winches in an almost infinite number of combinations, making it impossible for the barge operator to effect correct load allocations on a real-time basis while maintaining static and dynamic balances between the barge/stinger and the sea bed. To solve these problems, an integrated process computer control system named VALBOCS was developed (an acronym for Vanguard of Lay Barge Operation Control System). This system was successfully employed on board the lay barge Kuroshio II in a project. This paper describes VALBOCS.

56583 Estimation of lay barge operating rates by model testing. Sekita, K.; Taniyama, M.; Nishimura, K. pp 285-290 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Great numbers of submarine pipelines for the transportation of petroleum, gas, and water have been recently constructed worldwide, and many others now are being constructed or planned. Most submarine pipelines are laid by the lay-barge method. But adverse deep-sea conditions cause excessive dynamic stresses to occur in pipe being laid, making it difficult to ensure safe and reliable pipeline installation. To analyze the dynamic behavior characteristics of the lay barge, the stinger, and the pipe being laid under unfavorable deep-sea conditions, model tests were conducted using a 1/60th scale lay-barge model and irregular waves with sites assumed to be Southeast Asian offshore areas in depths of 75 m.

56584 Total pipelaying system dynamics. Cowan, R.; Andris, R.P. pp 291-302 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A method is presented for predicting the dynamic responses of a total pipelaying system undergoing excitations from high sea states and vessel motions in deep or shallow water. The method is used to predict the interactions between all components in a pipelaying system such as the lay barge; rigid, flexible, or articulated stinger; pipe; soil; currents; and wave forces from regular or random seas. The method incorporates a combination of coupled rigid body and flexible finite element models in a three dimensional time domain. This technique accounts for nonlinearities such as hydrodynamic damping and large angle deflections in pipe and stinger as well as discontinuities such as pipe separation from supports on the vessel/stinger assembly and rotational stops between elements of an articulated stinger. The approach assembles all the essential components within a pipelaying system and evaluates the total system under various static and dynamic environments. The investigations can then lead to predicting limiting environments for specific pipelaying designs as well as establishing and optimizing designs for specific operational and environmental conditions. The criteria used in evaluating pipelaying systems consist of stress magnitudes in pipe and stinger, resonant conditions, dynamic deflections and excursions, tensioner requirements, vessel motions, and station keeping requirements. A sample case of a specific 2 dimensional system with a flexible stinger operating in deep water undergoing regular wave excitation was investigated with this technique and the results are presented.

56585 Four flexible pipes and control lines are laid simultaneously from a dynamically positioned vessel. de Panafieu, P.; Behar, I. pp 315-326 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The structure of the high pressure flexible pipes compatible with TFL tools and the tests performed are described. The new dynamically positioned vessel specially designed to lay the flexible pipes is described along with the laying procedure and the performance on the field.

56586 Wave-induced scour around offshore pipelines. Herbich, J.B. (Texas A and M Univ., College Station). pp 79-90 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The size, numbers and applications of offshore pipelines are steadily increasing; pipelines carry crude oil from oil fields to shore; refined oil from offshore ports; municipal and industrial waste from sore into deeper water; in the future, bulk commodities may be carried from offshore ports to shore. In all cases, a pipeline must cross the surf zone before getting into deeper water and in most cases, the pipelines are in the zone of intense dynamic action caused by waves during storms, appreciable movement of sediment, onshore currents and littoral currents. There have been many failures of offshore pipelines during the last ten years and there appear to be several reasons for the failures, notably inadequate cover and low specific gravity of the pipeline. Under the first category the depth of burial may be insufficient, the quality of burial soil may be inferior to the soil outside of the trench, or the compaction of cover soil may be inadequate. Under the second category the pipe may actually float to the surface of the ocean bed as the soil around the buried pipe liquefies. An extensive laboratory study was conducted to evaluate the development of underwater bars and scour patterns around the pipe with the pipeline buried at various depths below the ocean bed. The analysis of experiments indicates that depth of scour around offshore pipelines under certain wave conditions is greater than anticipated. The pipe itself causes additional scour around it. Recommendations as to the minimum depth of burial are given.

PROPERTIES

REFER ALSO TO CITATION(S) 56550

COMBUSTION

56587 (LBL—8007) Reduction of nitric oxide by carbon monoxide over a silica supported platinum catalyst: infrared and kinetic studies. Lorimer, D.H. (California Univ., Berkeley (USA). Lawrence

Berkeley Lab.). Jul 1978. Contract W-7405-ENG-48. 169p. Dep. NTIS, PC A08/MF A01.

Thesis.

The reduction of nitric oxide by carbon monoxide over a 4.5 weight percent platinum catalyst supported on silica was studied at 300°C. Reaction rate data was obtained together with in situ infrared spectra of species on the catalyst surface. The kinetics of the system were found to exhibit two distinct trends, depending on the molar ratio of CO/NO in the reactor. For net reducing conditions (CO/NO greater than 1) the catalyst underwent a transient deactivation, the extent of which was dependent on the specific CO/NO ratio during reaction. Reactivation of the catalyst was obtained with both oxidizing and reducing pretreatments. A reaction mechanism based on the dissociation of nitric oxide as the rate-limiting step was used to correlate nitric oxide reaction rates and nitrous oxide selectivities observed under reducing conditions. As part of this mechanism it is assumed that nitrous oxide is formed via a Langmuir-Hinshelwood process in which an adsorbed nitrogen atom reacts with an adsorbed nitric oxide molecule. The nitric oxide reaction rate was found to be first order in nitric oxide partial pressure, and inverse second order in carbon monoxide partial pressure. A mechanism is proposed to qualitatively explain the deactivation process observed under reducing conditions. The essential part of this mechanism is the formation of an isocyanate species on the Pt crystallites of the catalyst and the subsequent transient diffusion of these species to the silica support. The deactivation is believed to result from the build-up of NCO on vacant sites necessary for the dissociation of nitric oxide.

NATURAL GAS

REFER ALSO TO CITATION(S) 56475, 56476, 56477, 56478

RESERVES

REFER ALSO TO CITATION(S) 57065

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 56408, 56480, 56483, 56485, 56487, 56488, 56493, 56498, 56500, 56501, 56503

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 56509, 56511, 56514, 56516, 56517, 56519, 56520, 56521, 56522, 56524, 56525, 56527, 56528, 56532

56588 (TID—28600) **Quarterly progress report [on gas production from shale], April—June 1978.** Kirk, K.G.; Nuckols, E.B. III; Long, B.R.; Rauch, H.W.; Wilson, T.H.; Dixon, J.M.; Evans, M.; Negus de Wys, J. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1978. Contract EY-76-C-05-5194. 57p. Dep. NTIS, PC A04/MF A01.

All regional structure maps of shales have been completed in rough draft or preliminary map form. Fracture studies show that shale gas production from eastern Kentucky and southern West Virginia comes from layers of more intense fracturing associated with the lower shales and most often the organic-rich portions. Production of Devonian Shale in the Cottageville gas field has been characterized; correlations have been established between photolineaments and water well productivity. Seismic and surface studies are also reported. (DLC)

56589 **Offshore chemical processing of associated natural gas: a case study of methanol production at the offshore well.** Hollyer, R.S.; Helerman, L.W. pp 255-264 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Offshore gas sources too small to support a pipeline to shore represent a serious gas management problem. This is particularly true of associated gas from a producing oil field which for environmental or political reasons can no longer be flared. One possible solution to this problem is to convert the gas to some product which can be transported with the oil or in tankers. One such product is methanol. Using methanol as an example, a procedure is presented illustrating how an analysis of the technical and economic feasibility of an offshore processing plant can be conducted.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 56533, 56534

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 56537

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 56542, 56543, 56548, 56549, 56593

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

56590 (SAND—78-0664C) **Detection within the wellbore of seismic signals created by hydraulic fracturing.** Schuster, C.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 10p. (CONF-781003—3). Dep. NTIS, PC A02/MF A01.

From 53. technical conference and exhibition; Houston, TX, USA (1 Oct 1978).

Early in 1978, Sandia Labs participated in massive hydraulic fracture mapping experiments with Amoco in the Wattenburg area. On two of these massive hydraulic fractures in the Sussex formation, a downhole, wall clamped, three-axis geophone was tested. On the first experiment, the system was clamped in the open hole section during the breakdown phase. On the second experiment, the system was located in the lubricator during the main fracture and was lowered into place after shut-in. Breakdown pump of the first experiment was conducted in four phases. The formation was first broken down and shut-in for a quiet period and then three 5000 gallon stages of fluid without proppant were pumped with a quiet period after each one. Following the last quiet period, flow back was started and half way through a shut-in was scheduled for the fifth and last quiet period. During even the smallest flow rates, the noise induced into the geophones was extremely large and masked any other seismic activity. During the quiet periods, several seismic events were observed. These apparently are from two sources: (1) motion associated with permanent movements of the fracture face and (2) high frequency impulsive sources possibly associated with thermal fracturing. Following the 124,000 gallon fracture on the second experiment, the seismic system was lowered into place and clamped into the casing 50 feet above the open hole section that had been fractured. Seismic signals were recorded for approximately six hours after shut-in when the test was terminated. Both types of signals seen on the early experiment also appear to be present after the fracture treatment.

56591 (SAND—78-0666C) **Massive hydraulic fracture mapping and characterization program.** Schuster, C.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 11p. (CONF-780825—1). Dep. NTIS, PC A02/MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

Sandia Laboratories has continued the development and field testing of the surface electrical potential system. Several experiments have demonstrated the ability of this technique to determine fracture orientation and asymmetry. Applicability to deeper, smaller, multizone, and other types of fracturing is continuing to be evaluated. Surface seismic recording as a tool to evaluate fracturing has been discontinued; however, close-in seismic recording appears to be quite valuable. Two different types of experiments revealed a preponderance of seismic events associated with hydraulic fracturing. Geophones had been grouted into the formation at the Nevada Test Site in close proximity to the fracturing experiments in Hole 6. A downhole, wall-clamped three-axis seismic system was tested on two experiments in the Wattenburg field. All these experiments indicate that seismic recordings made close to or in the fracture system potentially can be of significant value to assist in fracture mapping.

56592 (SAND—78-0682C) **Stimulation and Mineback Experiment Project. The direct observation of hydraulic and explosive fracturing tests.** Northrop, D.A.; Warpinski, N.R.; Schmidt, R.A.; Smith, C.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 14p. (CONF-780825—2). Dep. NTIS, PC A02/MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

Hydraulic and explosive fracturing experiments have been conducted adjacent to an existing tunnel complex at DOE's Nevada Test Site and have been directly observed by subsequent mineback through the experimental area. A proppant distribution fracture experiment revealed a very complex fracture system. Observed

fracture lengths were only 5 and 25 ft at the depth of the fracture interval and these differ significantly from the design lengths of 175 ft. The fracture interacted with numerous geologic faults, fractures, and bedding and parting planes. Variations of the in situ stresses and orientations were found in subsequent testing in this experiment region. An experiment was designed and conducted which examined the behavior of hydraulic fractures at an interface between an ashfall tuff and a welded tuff formation interface. These formations have significant differences in their elastic moduli (0.24×10^6 and 3.8×10^6 psi), Poisson's ratios (0.312 and 0.238) and porosities (45 and 13%). One fracture has been located via exploratory coring and mineback along the fracture is under way. In conjunction with a nuclear containment program, the residual stress effects around a contained explosive detonation have been studied. Mineback through a region surrounding a 256 lb TNT detonation indicated that no radial fractures extended from the main cavity. The use of small volume (<50 gal) hydraulic fractures in tunnel boreholes has been evaluated for determining in situ stresses and orientations in conjunction with this project.

56593 (UCID—17851) **Environmental impact assessment: stimulation of gas recovery in the devonian shale, Wetzel County, West Virginia.** O'Banion, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jul 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The Morgantown Energy Research Center of the U.S. Department of Energy (DOE) has contracted with Mobay Corporation to share the cost of hydraulic stimulation of the Devonian Shale at a site in Wetzel County owned by Mobay. This contract is one of several awarded to natural gas producers by DOE to test methods to increase gas recovery from the Devonian Shale formation. This formation, underlying over 250,000 mi^2 of the U.S., contains huge volumes of natural gas, but to date has yielded only marginal amounts because of the low permeability of the rock. Mobay will use the gas recovered by this project as feedstock at its chemical plant in New Martinsville. The project, situated about 2 mi northeast of New Martinsville in a sparsely populated area of steep, forested hills, will involve grading a level pad, drilling and coring one wall, and fracturing the shale interval of the well by one of two hydraulic methods. The method will be selected only after analyzing the coring data. Some erosion and disruption of wildlife may result from the removal of vegetation, but only in an area of 1 acre; the site will be regraded and reseeded when the frac operation is completed. Noise and airborne dust will increase temporarily during construction and fracturing, but because of the remote location only workers at the site should be affected discernably. Because Mobay is a major employer in the region, its acquisition of a reliable, noninterruptible source of gas should help stabilize the local economy. No other potential impacts are identified with the project.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 56567, 56568, 56569, 56570, 56571, 56572, 56573, 57067, 57436

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 56580, 56581, 56582, 56583, 56584, 56585, 56586

56594 (AD-A—049883) **Preliminary evaluation of wind and wave effects at potential LNG terminal sites, State of California. Final report.** Hales, L.Z. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Jan 1978. 236p. (WES-MP-H—78-2). NTIS PC A11/MF A01.

The California Legislature decreed that the California Coastal Commission had until 1 February 1978 to identify, evaluate, and rank alternate potential Liquefied Natural Gas (LNG) Terminal sites on the California coast. Because of the Corps' experience in various aspects of such studies, the U. S. Army Engineer Waterways Experiment Station was requested by the Coastal Commission to assist, particularly in the use of existing hindcast data to evaluate possible effects of wind and waves on the docking and unloading of a LNG tanker. The effect of wind and wave climate was relatively evaluated at 26 potential LNG terminal sites along the coast of California. The analysis did not apply wave refraction theory at any of the sites, so the absolute magnitudes of the values obtained at each site are subject to refinement. The computations which were performed were optimized on a site-specific basis; i.e., they have been determined by utilizing the situations unique to that one particular location, and the results should not be extrapolated far beyond the respective site, if at all.

56595 (PNL—2422) **Energy material transport, now through 2000 system characteristics and potential problems. Task 4 progress report: natural gas transportation.** DeSteese, J.G.; Geffen, C.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1978. Contract EY-76-C-06-1830. 71p. Dep. NTIS, PC A04/MF A01.

A summary characterization is presented of the existing natural gas transportation system and an assessment of some potential problems which may impact natural gas transportation in the United States during the balance of the century. A primary purpose of this task is to provide information and perspective that contributes to the evaluation of research needs and priorities in future programs. Safety and environmental issues that should concern the gas industry, the Department of Energy (DOE) and other cognizant government agencies are emphasized. Specific potential problems are identified which warrant additional programmatic effort because they do not appear to be receiving adequate attention. New programs are recommended to address these concerns according to their apparent importance, under conditions known or anticipated in early 1978. Other safety and environmental concerns in natural gas transportation are also reviewed, and judged to be adequately addressed in ongoing programs. No additional effort appears to be needed in these areas at present.

56596 **Joule-Thomson effects on turbulent Graetz problem for gas flows in pipes with uniform wall temperature.** Cheng, K.C.; Ou, J.W. (Univ. of Alberta, Edmonton). *Can. J. Chem. Eng.;* **56**: No. 1, 31-36(Feb 1978).

The Joule-Thomson effect is known to be important in arctic gas pipelines. The Joule-Thomson effects on forced convective heat transfer in the thermal entrance region of pipes with uniform wall temperature are studied for steady fully developed turbulent gas flows by the Graetz method. Thermal entrance heat transfer results are presented for Prandtl number 0.72, Reynolds number 10^5 and Brinkman number +- 0.1, +- 1.0 with Joule-Thomson parameter J/sub μ/ ranging from 0 to 1.0 to cover the possible range in practical applications. Bulk temperatures and Nusselt numbers are also presented for fully developed flow with Reynolds numbers from 5×10^3 to 10^6. For given Prandtl and Reynolds numbers, the asymptotic Nusselt number is found to be dependent on the Joule-Thomson parameter only and is independent of Brinkman number. The fully developed bulk temperature is a linear function of Brinkman number and a linear relationship exists between the bulk temperature parameter (-theta/sub bf//Br) and the Joule-Thomson parameter J/sub μ/ for given Prandtl and Reynolds numbers.

56597 **Wind and current shape coefficients for very large crude carriers.** Benham, F.A.; Fang, S.S.; Fetters, C.H. (Exxon Research and Engineering Co., Linden, NJ). pp 97-108 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A research program is described carried out by the Oil Companies International Marine Forum to develop wind and current shape coefficients for large tankers. A review and comparison of previously developed wind and current force prediction data had revealed wide discrepancies or gaps among the data heretofore in the public domain. The present research effort has resulted in the development of a standardized set of shape coefficients for use by the marine industry to predict forces and moments due to wind and current acting on moored Very Large Crude Carriers.

56598 **Technical review of the Frigg pipelines construction.** Lallier, L.; Jegou, A. (Compagnie Francaise des Petroles, Paris). pp 303-314 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Frigg pipelines with 730 kilometers of 32 inch line constitute one of the largest pipeline systems in the North Sea and will transport in excess of 15 billion m^3 of natural gas per year from the Frigg field to Scotland. The Frigg pipeline system is described along with the major construction equipment involved in its construction. The history of the construction is given with emphasis on planning decisions in relation with lay barge and tie in and repair operations.

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 56588

SITE GEOLOGY

56599 Bibliography of the geology of the Green River formation, Colorado, Utah, and Wyoming, to 1 March 1977. Mullens, M.C. *U.S. Geol. Surv., Circ.;* No. 754, 1-52(1977).

This bibliography of 895 references was compiled to aid studies on the geology and resources of the Green River Formation. References included are mainly on the areal geology, stratigraphy, paleontology, geochemistry, and mineralogy of the Green River Formation, but some concern development of the oil-shale deposits. Recent studies also concern the effects that an oil-shale industry will have on the environment. The bibliography is arranged in three parts: U.S. Geological Survey reports on the Green River Formation; reports by U.S. Geological Survey authors on geology of the Green River Formation in non-U.S. Geological Survey publications; and selected reports by non-U.S. Geological Survey authors on the geology of the Green River Formation.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 56526

IN SITU METHODS, TRUE AND MODIFIED

56600 (UCID—17854) **Oil shale project run summary for small retort Run S-10.** Ackerman, F.J.; Sandholtz, W.A.; Raley, J.H.; Laswell, B.H. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

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A combustion run using sidewall heaters to control heat loss and computer control to set heater power were conducted to study the effectiveness of the heater control system, compare results with a one-dimensional retort model when radial heat loss is not significant, and determine effects of recycling off-gas to the retort (by comparison with future runs). It is concluded that adequate simulation of in-situ processing in laboratory retorts requires control of heat losses. (JRD)

SURFACE METHODS

56601 Cryogenic recovery of tar from Athabasca tar sands. Welmers, A.; Bergougnou, M.A.; Baker, C.G.J. (Univ. of Western Ontario, London). *Can. J. Chem. Eng.;* **56**: No. 1, 99-102(Feb 1978).

Cryogenic recovery of tar from Athabasca tar sand could be an attractive alternative to the conventional hot water separation process. It is based on the fact that when frozen tar sand is ground, distinct particles of tar and sand are obtained and can be separated by elutriation. A specially designed fluidized bed grinder was developed for operation at temperatures in the range -30 to -130°C. Preliminary experiments have shown that 88% of the tar can be removed from the sand. Improved results can be expected after further optimization of the unit.

ENVIROMENTAL ASPECTS

56602 (COO—4043-1) **Analysis of the environmental control technology for oil shale development.** de Nevers, N.; Eckhoff, D.; Swanson, S.; Glenne, B.; Wagner, F. (Utah Univ., Salt Lake City (USA). Coll. of Engineering). Feb 1978. Contract EY-76-S-02-4043. 301p. Dep. NTIS, PC A14/MF A01.

The environmental control technology proposed in the various oil shale projects which are under development are examined. The technologies for control of air pollution, water pollution, and for the disposal, stabilization, and vegetation of the processed shale were thoroughly investigated. Although some difficulties may be encountered in any of these undertakings, it seems clear that the air and water pollution problems can be solved to meet any applicable standard. There are no published national standards against which to judge the stabilization and vegetation of the processed shale. However, based on the goal of producing an environmentally and aesthetically acceptable finished processed shale pile, it seems probable that this can be accomplished. It is concluded that the environmental control technology is available to meet all current legal requirements. This was not the case before Colorado changed their applicable Air Pollution regulations in August of 1977; the previous ones for the oil shale region were sufficiently stringent to have caused a problem for the current stage of oil shale development. Similarly, the federal air-quality, non-deterioration regulations could be interpreted in the future in ways which would be difficult for the oil shale industry to comply with. The Utah water-quality, non-deterioration regulations could also be a problem. Thus, the only specific regulations which may be a problem are the non-deterioration parts of air and water quality regulations. The unresolved areas of environmental concern with oil shale processing are mostly for the problems not covered by existing environmental law, e.g., trace metals, polynuclear organics, ground water-quality changes, etc. These may be problems, but no evidence is yet available that these problems will prevent the successful commercialization of oil shale production.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 57072, 57074

RESERVES

REFER ALSO TO CITATION(S) 57065

EXPLORATION

56603 (DP-MS—78-67) **Use of NURE regional geochemical data in geologic mapping.** Price, V. Jr.; Ferguson, R.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 9p. Dep. NTIS, PC A02/MF A01.

The objective of this paper is to point out the copious regional geochemical data available through the U.S. DOE National Uranium Resource Evaluation (NURE) Program and to demonstrate the potential of such data as a tool for geologic mapping in the southeastern piedmont. The data presented cover the Charlotte NTMS quadrangle. 6 figures.

56604 (GJBX—35-78) **Evaluation of uranium potential in selected Pennsylvanian and Permian units and igneous rocks in southwestern and southern Oklahoma. Final report.** Al-Shaieb, Z.; Shelton, J.W.; Donovan, R.N.; Hanson, R.E.; May, R.T.; Hansen, C.A.; Morrison, C.M.; White, S.J.; Adams, S.R. (Oklahoma State Univ., Stillwater (USA). Dept. of Geology). 15 Jun 1977. Contract EY-76-C-13-1664. 388p. Dep. NTIS, PC A17/MF A01.

Precambrian and Cambrian igneous rocks and Pennsylvanian-Permian sedimentary rocks in southwestern and southern Oklahoma are related genetically in that the former, by means of tectonism, was the dominant source material for sediments composing a substantial part of the latter. Petrological and geochemical evidence indicate that granite and rhyolite are potential sources of uranium in southwestern Oklahoma. Riebeckite-aegirine pegmatite dikes contain 38 to 108 ppM uranium. Most of the uranium anomalies in sedimentary rocks are present in association with structural features. Local reducing conditions favoring precipitation from ground water were due to seepage of hydrocarbons along faults, concentration of carbonaceous material (in one case), and deposition of cornstone (caliche). In the Vanoss Formation, the anomalous uranium content in ground water is associated with coarse-grained, arkosic facies. The structural configuration appears to have been relatively unimportant in localization of the anomalies. Some of the disseminated uranium in framework grains and clay in arkoses and subarkoses in southwestern Oklahoma was leached by ground water and transported both parallel to and across bedding (by means of fractures and capillary pressure) to local areas favorable for precipitation.

56605 (GJBX—50(78)(Vol.1)) **Aerial gamma ray and magnetic survey: Peninsula portion, Hancock Quadrangle, Michigan; Ashland Quadrangle, Wisconsin/Minnesota/Michigan; Iron River Quadrangle, Michigan/Wisconsin; and Marquette Quadrangle, Michigan. Final report .** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 175p. Dep. NTIS, MF A01.

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Under the Department of Energy, National Uranium Resource Evaluation (NURE) Program, GeoMetrics, Inc., conducted a high sensitivity airborne radiometric and magnetic survey of the peninsula portion of the Hancock, the Ashland, the Iron River, and the Marquette 1 : 250,000 NMTS Quadrangles within the states of Wisconsin, Michigan, and Minnesota. A total of 6,430 line miles (10,288 line kilometers) of high sensitivity radiometric and magnetic data were collected within these quadrangles. Traverse lines were flown at a spacing of 3.125 miles (5 kilometers) in an east/west direction with tie lines flown in a north/south direction at an 18.375 miles (30 kilometers) separation. All data were collected utilizing a fixed wing aircraft and over 3,500 cubic inches of NaI crystal detector. Magnetometer data were collected utilizing a high sensitivity proton magnetometer. Data were recorded digitally at 1.0 second intervals aboard the aircraft. Navigation was performed using both visual and Doppler techniques. All data are presented in this report as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperatures and airborne bismuth contributions. Radiometric data presented are corrected for

Compton scatter, altitude dependence and atmospheric bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data.

56606 (K/UR—101) **National Uranium Resource Evaluation Program. Hydrogeochemical and stream sediment reconnaissance basic data for Plainview NTMS Quadrangle, Texas. Uranium Resource Evaluation Project.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 8 Jun 1978. Contract W-7405-ENG-26. 127p. (GJBX—92(78)). Dep. NTIS, MF A01.

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Results of a reconnaissance geochemical survey of the Plainview Quadrangle, Texas are reported. Field and laboratory data are presented for 969 groundwater samples and 571 stream sediment samples. Statistical and areal distributions of uranium and other possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. At least two different types of groundwater occur in the Plainview Quadrangle. One is associated with the Permian units and is characterized by high conductivity values with high concentrations of U, Mo, and sulfate. The other is associated with the Ogallala Aquifer System and is characterized by high alkalinity values and high concentrations of As, Li, Mo, Se, and V. Steam sediment results indicate that two distinct associations between uranium and other elements occur in the Plainview Quadrangle. An association consists of high soluble U values accompanied by relatively low total-to-soluble uranium ratios with high values for V, Li, and to a lesser extent, As and Se. This association is indicative of the type of secondary mineralization expected in sedimentary units which is related to commercial potential. The other association consists of high values of total U and high total-to-soluble U ratios with high values for Ba, Mn, Ti, Th, and Zr. This association is indicative of heavy and resistate mineral suites which are less favorable for commercial potential.

56607 (LA—6649-MS) **Uranium concentrations in stream waters and sediments from selected sites in the eastern Seward Peninsula, Koyukuk, and Charley River areas, and across South-Central Alaska.** Sharp, R.R. Jr.; Hill, D.E. (Los Alamos Scientific Lab., NM (USA)). Apr 1978. Contract W-7405-ENG-36. 45p. (GJBX—79(78)). Dep. NTIS, MF A01.

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During the summer of 1975, a 6-week reconnaissance was conducted in widespread areas of Alaska as part of the National Uranium Resource Evaluation (NURE) program; Water, stream sediment, and bedrock samples were taken from the eastern Seward Peninsula, from north of Koyukuk River, from the Charley River area, and from across south central Alaska. This report contains the LASL uranium determinations resulting from fluorometric analysis of the water samples and delayed-neutron counting of the stream sediment samples. Results of total uranium for 611 water and 641 sediment samples, from 691 stream locations, are presented. Overlays showing the numbered sample locations and graphically portraying the concentrations of uranium in water and stream sediment samples, at 1:250,000 scale for use with existing National Topographic Map Series (NTMS) sheets and published geologic maps, are provided as plates. The main purposes of this work are to make the uranium data available to the public in the standard computer format used in the NURE Hydrogeochemical and Stream Sediment Reconnaissance (i.e., with a DOE sample number giving the latitude and longitude of each sample location) and to provide uranium concentration overlays at the standard scale of 1:250,000 adopted by the DOE for the NURE program. It also allows a plausible explanation of differences between the uranium values for sediment as determined by acid dissolution/extraction/fluorometry and by delayed-neutron counting that were noted in the earlier report.

56608 (GJBX—50(78)(Vol.2a)(AQ)) **Aerial gamma ray and magnetic survey: Ashland Quadrangle, Wisconsin/Michigan/Minnesota. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 29p. Dep. NTIS, MF A01.

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Data generated from an aerial gamma ray and magnetic survey of the Ashland Quadrangle in Wisconsin/Michigan/Minnesota are presented. (LK)

56609 **Radioactivity and mineral composition of bauxites.** Parshakov, N.S.; Menyaylov, A.A.; Laubenbakh, A.I.; Skosyreva, L.N.; Slavyagina, I.I. *Int. Geol. Rev.;* **19**: No. 6, 737-740(Jun 1977).

Translated from Izv. Vyssh. Uchebn. Zaved., Geol. Razved.; 19: No. 6, 32-36(1976).

Radioactivity of bauxites depends mainly on thorium, the amount of which always exceeds that of uranium. The amount of radioactive elements in bauxites depends mainly on their material composition, which, in turn, depends mainly on the composition of the parent rocks from which bauxites were formed.

FEED PROCESSING

56610 **Basic study on uranium extraction from sea water, (2). Extraction of U(VI) by polyacrylamide gel containing various metal hydroxides.** Shigetomi, Y.; Kojima, T. (Okayama Coll. of Science (Japan)); Shinagawa, M. *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 11, 811-815(Nov 1977).

The possibility was examined of extracting U (VI) from sea water by adsorption on gel particles containing various metal hydroxides, including $Ti(OH)_4$ and $Zn(OH)_2$, dispersed in polyacrylamide gel particles. The hydroxide adsorbent thus prepared in gel form was packed in a column for processing the sea water (both sea water sampled from harbor and artificially prepared solution). The U(VI) collected in the column was eluted with 0.10 M Na_2CO_3 solution. Factors affecting the performance of the hydroxide adsorber were examined: The kind of metal hydroxide used, the degree of cross-linking of the polyacrylamide, the content of hydroxide in the gel and the concentration of U(VI) in the original sea water. Of the five kinds of metal hydroxides tried, only titanium hydroxide was found to function usefully as adsorbent for the U(VI). The degree of polyacrylamide crosslinking was found have no relation to adsorption performance, which, on the other hand, was significantly influenced by changes in titanium hydroxide in the gel: The amount of U(VI) adsorbed reached a maximum at 2 mg Ti/ml gel. Also, the adsorption improved consistently with decreasing concentration of U(VI) contained in the original sea water, down 10^{-6} M.

56611 **Method and equipment to extract dissolved, suspended or chemically bonded substances from a liquid.** Bals, H.G. (to Uranerzbergbau G.m.b.H. und Co. K.G.). German(FRG) Patent 255,751/A/. 26 May 1977. 19p. (In German).

The method invented is especially for the recovery of uranium or other heavy metals too from seawater. The slight concentration of uranium in seawater sofar has not been worthwhile for a large technical recovery, especially as the hitherto known or proposed methods are mostly of an adsorption nature and the necessary equipment due to considerable disadvantages (such as e.g. too high a flow resistance with solid adsorber beds; too great an abrasion due to uncontrolled whirling motion of the adsorber particles; only discontinuous operation possible etc.) cannont be economically justified. In the method described here, a vertical upward flow through the adsorber bed is stabilized and made uniform before entering the bed by a special device (grid, sieve or holed plate) with about half the flow resistance compared to the adsorber bed, and is then slowed down uniformly by the enlarged cross-section like a diffusor. The adsorber particles are distributed uniformly over the flow cross-section kept in suspension for as long as the essential influencing parameters (weight, particle shape, flow rate etc.) experience no change. The gradual charging of the adsorber particles with heavy metal taken up from the solution and the thus involved gain in weight and the simultaneously increasing relative sinking rate cause a slow passage of the particles from the inlet to the outlet. Entrance and removal may go on continuously.

56612 **Separation of ^{230}Th (ionium) from uranium ores in sulfuric acid and in nitric acid solutions.** Kluge, E.; Lieser, K.H.; Loc, I.; Quandt, S. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie). *Radiochim. Acta;* **24**: No. 1, 21-26(1977).

^{230}Th (ionium) is of interest for production of ^{231}Pa, the Pa isotope with the longest half life, and for production of ^{232}U which can be used in radionuclide batteries. Two procedures are presented which have been worked out for separation of ^{230}Th from sulfuric acid and from nitric acid solutions. In the first case the effluents from the anion exchange resins are the starting material for recovery of ^{230}Th, in the second case the cation exchange resins which are for purification of U. The procedures selected are simple, economic and can be performed in any uranium mill or uranium purification plant without additional investments.

ENRICHMENT

56613 **Inverse break-through process for uranium isotope separation by elution of U(IV) with ferric nitrate solution.** Paunescu, N.; Calusaru, A. (Academia R.S.R., Bucharest (Romania). Institutul de Fizica). *Isotopenpraxis;* **14**: No. 5, 160-163(May 1978).

An inverse break-through process consisting in the elution of a strong cationic resin containing U(IV) with a ferric nitrate solution at several concentrations has been carried out. For $Fe(NO_3)_3$, 0.1 M, an apparent equilibrium constant of 1.00217 has been obtained at room temperature, which indicates an acceleration of the isotopic

exchange reaction between U(IV) in resin form and U(IV) in solution in the presence of the nitrate anion. This exchange reaction allows to increase the ^{235}U concentration in the liquid phase. The accelerating effect of NO_3^- is explained considering both the oxidizing and the low complexing properties of the nitrate anion.

56614 Resolution of inconsistencies of separative power for asymmetric process. Separative power with respect to desired and undesired materials. Yamamoto, I.; Kanagawa, A. (Nagoya Univ. (Japan). Faculty of Engineering). *J. Nucl. Sci. Technol. (Tokyo);* **14**: No. 8, 565-571(Aug 1977).

A separative power of a separating process delta U is an increase of a value an isotope mixture which passes through the process, and is calculated by use of a value function V(R)(R: abundance ration). The separative power, however, involves various inconsistencies especially for an asymmetric process. To remove these inconsistencies, concepts of a "separative power with respect to desired material delta U sub(b)" and that delta U sub(a) with respect to undesired material are introduced. Two functional forms, having been considered to be the separative power (with respect to mixture) per unit flow rate delta U/(G sub(a+G)b), correspond to separative powers per unit flow of desired and undesired material delta U sub(b)/G sub(b), delta U sub(a)/G sub(a), respectively: delta U sub(b)/G sub(b)=($\alpha(\beta$-1)ln α-(α-1)ln β)/($\alpha\beta$)=phi sub(b)(α,β), delta U sub(a)/G sub(a)=($\beta(\alpha$-1)ln β-(β-1)ln α)/($\alpha\beta$-1)=phi sub(a)(α,β), where α and β are heads and tails separation factors. Value functions which give delta U sub(b) or delta U sub(a) are independent of separation factors: V sub(b)(R)=ln R, V sub(a)(R)=-ln R, so inconsistencies encountered by delta U never occur. delta U sub(b) or delta U sub(a) of a single element and of a cascade are obtained by the same functional form, and an additivity of separative power holds both for the desired and undesired material, respectively. Moreover, the separative power delta U with respect to mixture is interpreted with delta U sub(b) and delta U sub(a) to elucidate the origines of inconsistencies.

GASEOUS DIFFUSION

56615 (K/P—6452) Handling of UF_6 in U.S. gaseous diffusion plants. Legeay, A.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1978. Contract W-7405-ENG-26. 35p. (CONF-780669—1). Dep. NTIS, PC A03/MF A01.

From Specialist meeting; Boekelo, Netherlands (27 Jun 1978).

A comprehensive systems analysis of UF_6 handling has been made in the three U.S. gaseous diffusion plants and has resulted in a significant impact on the equipment design and the operating procedures of these facilities. The equipment, facilities, and industrial practices in UF_6 handling operations as they existed in the early 1970's are reviewed with particular emphasis placed on the changes which have been implemented. The changes were applied to the systems and operating methods which evolved from the design, startup, and operation of the Oak Ridge Gaseous Diffusion Plant in 1945.

LASER EXCITATION

56616 (UCRL—52453) Effects of alternative transition sequences on coherent photoexcitation. Einwohner, T.H.; Wong, J.; Garrison, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Apr 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The photoexcitation part of laser isotope separation can lead to a situation more complicated than a simple chain of transitions between successive pairs of energy levels. In the rotating wave approximation, coherent photoexcitation for these situations leads to graphs with side branches or cycles. For many cases a simple change of basis removes the time dependence of the interaction Hamiltonian and reduces the calculation of level populations and interlevel flows to an eigenvalue problem. Analytical and numerical examples are shown. It is shown that a side branch with a large matrix element strongly inhibits the flow of population along the path to which it is attached. The dependence of populations and flows on phase differences when the radiation consists of several phase-locked fields with different frequencies is studied. For acyclic graphs, there is no phase dependence. For a cycle, the phase dependence is on one parameter which is a linear combination of the phases associated with the cycle. In a simple example photoexcitation was changed from that of complete population inversion to that of no population inversion by varying that parameter.

FUELS PRODUCTION AND PROPERTIES

56617 Determination of impurities in $^{233}UO_2$ by spark source mass spectrometry. Franklin, J.C.; Landau, L.; Donohue, D.L.; Carter, J.A. (Oak Ridge National Lab., TN). *Anal. Lett.;* **A11**: No. 4, 347-354(1978).

A method for the determination of impurities in $^{233}UO_2$ has been developed and applied to the analysis of a product stream of ceramic grade $^{233}UO_2$ powder. The analytical method has combined isotope dilution and internal standard methods to permit the determination of impurities at concentrations between 0.1 and 500 ppM in a single sample.

56618 Method for the production of spherical fuel and breeder material particles. Huschka, H.; Kadner, M. (to Hochtemperatur-Reaktor-Brennelement G.m.b.H. (HOBEG)). German(FRG) Patent 2,459,445/C/. 26 May 1977. 8p. (In German).

An improvement of the method for forming uniform spherical nuclear fuel particles is described which are made by precipitation from uranium- or thorium-containing solutions in an ammonia solution. A controlled liquid-jet is dropped into an ammonia solution (3,000 drops per minute) where uranium oxide and/or thorium oxide is precipitated, then dried and sintered. In order to stabilize the exact spherically shaped droplets formed during the fall, it is suggested according to the invention to introduce ammonia gas in the falling path at the point at which the droplets became spherical, in counter current as well as in horizontal stream so that the surfaces of the droplets are sufficiently hardened before plunging into the liquid.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 56637, 56660, 57262

56619 (BARC—915) Studies on inorganic ion-exchangers. Part I : application of polyantimonic acid for the polishing of uranium product of reprocessing stream. Murthy, T.S.; Ananthakrishnan, M.; Mayan Kutty, P.C.; Mani, V.V.S.; Nadkarni, M.N. (Bhabha Atomic Research Centre, Bombay (India)). 1977. 20p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A systematic study has been initiated to investigate the feasibility of applying various inorganic exchangers to specific problems in nuclear fuel reprocessing industry and related spheres of activity. An investigation has been carried out to select a suitable exchanger for the polishing of tail-end uranium product of reprocessing stream free of residual plutonium activity. It includes determination of distribution ratios of uranium and plutonium on the exchangers like zirconium phosphate (ZrP), ammonium phosphomolybdate (AMP), ammonium phosphotungstate (APW), polyantimonic acid (PA), polyphosphoantimonic acid (PPA) and breakthrough capacities of plutonium on some of these exchangers. The inhibition studies of sodium on plutonium uptake on polyantimonic acid and the effective decontamination factors achieved using uranium tanker solution from the plant for recycling work have been described. These results indicated the usefulness of the polyantimonic acid exchanger for this purpose.

56620 (GA-A—14705) Pneumatic conveying in HTGR nuclear fuel reprocessing. Richards, P.C.; Cook, E.J. (General Atomic Co., San Diego, CA (USA)). Apr 1978. Contract EY-76-C-03-0167-053. 17p. (CONF-780697—1). Dep. NTIS, PC A02/MF A01.

From 4. conference on the pneumatic transport of solids in pipes; Carmel, CA, USA (Jun 1978).

Pneumatic conveying is used to transport material between stages in the head-end of the fuel reprocessing pilot plant at General Atomic Company. The components selected for the conveying systems have generally performed well. Data regarding pressure drop, gas velocities, and solids flow rates have been correlated.

56621 (ICP—1160) Review of fission product nuclear data requirements for investigation of irradiated nuclear fuel: burnup measurements, neutron dosimetry, nuclear safeguards. Maeck, W.J. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Jul 1978. Contract EY-76-C-07-1540. 42p. Dep. NTIS, PC A03/MF A01.

The needs and accuracy requirements for fission product nuclear data (FPND) important to burnup measurements, neutron dosimetry, and safeguards have been reviewed. For burnup, the most pressing needs are for more accurate fission yields and a knowledge of the change in yields with neutron energy. For neutron dosimetry, improvements in certain fission yields and decay schemes are required. The needs for improved FPND for safeguards are not well defined. Until a firm plan for safeguarding nuclear materials is implemented and the exact data of interest are stated, current requests for improved FPND are assigned a lower priority than those for burnup, neutron dosimetry, and reactor physics.

56622 (TREE—1116, pp 223-226) Determination of minimum critical mass for fluorinel dissolvers. Jones, R.R.; Lofthouse, J.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Neutron criticality calculations were performed to evaluate the Fluorinel Dissolver design for Allied Chemical Company. The evaluation establishes the minimum critical mass and develops a means for specifying a safe loading limit for the system.

56623 (TREE—1116, pp 234) **HTGR dissolver criticality scoping calculation.** Shaffer, C.J. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A criticality scoping calculation was performed for a dissolver designed to dissolve HTGR fuels. The calculation shows the dissolver to go critical at an H/x (hydrogen-to-fuel ratio) of about 34 and peak with a k-effective of 1.18 at an H/x of about 180. (LK)

56624 **Countercurrent extraction column for liquid-liquid extraction.** Schmieder, H.; Goldacker, H.; Roos, W. (to Gesellschaft fuer Kernforschung m.b.H.). German(FRG) Patent 2,559,337/A/. 7 Jul 1977. 5p. (In German).

The invention refers to a countercurrent extraction column for use in the Purex process, the necessary reduction step for separating uranium and plutonium being carried out electrolytically within the column itself. The anode space, as described in the main patent, is enclosed by the cathode space without diaphragm. An improvement with respect to separating efficiency and a reduction of voltage drop is achieved by arranging a sheet metal cylinder, acting as a cathode unit, around the miner tube in the region of the borings between cathode space and anode space. Its inner space has been made accessible for the aqueous phase by means of borings on the upper side. The outer surface of the ring-shaped inner space contains radially mounted sheet-metal strips. The lower opening of the cathode metal-sheet cylinder is narrowed by a further, smaller cylinder provided with radial penetrations which are preceded by a dam for forming an S-shaped annulus, consisting itself, on the other hand, of a ringshaped sheet standing on the next lower perforated bottom.

56625 (BNWL-tr—324) **Problems of dismantling, treating, and analyzing highly irradiated fuel elements.** Lefort, G.; Allain, A.; Calame-Longjean, A.; Hayet, L.; Moreau, C.; Regnaud, F. (International Atomic Energy Agency, Vienna (Austria)). May 1976. Translated from pp 119-140 of IAEA-SM—209/60, 1976. 43p. Dep. NTIS (US Sales Only), PC A03/MF A01.

For some years hot laboratories have been receiving highly irradiated fuel elements from experimental reactors and new-generation power reactors. The hazards associated with these fuel elements are greater than those encountered in the past and it has been necessary to re-equip numerous facilities, improving the techniques used and the precautions taken in respect of personnel so that the operating conditions remain satisfactory. The operation of well-designed facilities doing this type of work has in fact become safer. Four representative facilities are described as examples--a dismantling cell with an inert atmosphere, associated with the Phenix reactor, a mechanical chopper cell for oxide fuel elements installed at the head of a pilot reprocessing plant, a radiometallurgy laboratory handling breeder fuel elements and californium, and a facility for chemical analysis of fuel elements. The paper shows that proper control has been established over the different hazards inherent in this type of facility in normal operation and in emergency conditions. These results are confirmed by the conditions of operation with teams having very long experience.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 56647, 56668, 57025, 57309, 57311

56626 (DOE/EIS—0015-D) **Draft environmental impact statement. Storage of U.S. spent power reactor fuel.** (Department of Energy, Washington, DC (USA)). Aug 1978. 237p. W.H. Pennington, Office of NEPA Affairs, Washington, DC.

The environmental impact of implementing or not implementing the policy for interim storage of U.S. spent fuel is analyzed. The same quantity of spent fuel (72,200 MTU from U.S. power reactors by the year 2000) is assumed throughout the statement. The statement is prepared on a generic, rather than a facility-specific basis. Two options associated with implementing the policy are examined: (A) centralized storage in large independent spent fuel storage (ISFS) basins owned or operated by the U.S. Government, and (B) decentralized storage in reactor basins and small privately owned ISFS basins. The work force will be exposed to radiation and will experience occupational accidents at rates comparable to those in similar industries. Uses of natural resources, releases of thermal and nonradioactive effluents, and secondary effects on biota are judged to have very minor impact. The population doses from environmental release of radioactivity determined for local (within 80 km of the facility), United States, and the world populations are given. Effects of long-lived nuclides in the 100-year period following the end of the study are included to provide an assessment of effects of persistent nuclides. The doses range from about 1000 man-rem to the world population for Alternative 1A, with disposition beginning in 1985, to 20,000 man-rem if fuel disposition is delayed until 1995. The number of facilities expected in the work force, including transportation workers, is about 11 for all the alternatives. The analyses find that the environmental risks from major abnormal events and accidents are very small and essentially the same for all alternatives. The differences in environmental impact between the options are small and for all options the associated environmental effects are within existing national standards and guidelines.

56627 (PNL—2637) **Sensitivity of the federal fee for managing spent fuel to financial and logistical variations.** White, M.K.; Lewallen, M.A.; Merrill, E.T.; Fleischman, R.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 49p. Dep. NTIS, PC A03/MF A01.

Three types of fees for federal spent fuel management service were calculated for a reference case and a number of variations. These fee types are a uniform fee applicable to all customers, a fee for disposal of spent fuel, and a fee for interim storage plus disposal of spent fuel. Results ranged from $124/kg to $256/kg for the uniform fee, $112/kg to $213/kg for the disposal fee, and $144/kg to $319/kg for the storage plus disposal fee. The reference case assumed that spent fuel would first be received by the government in 1983 at a 5,000 MT away-from-reactor (AFR) basin. The first repository (45,000 MT) was assumed ready for fuel in 1988, and the second (100,000 MT) in 1997. The reference case results in fees of $129/kg for the uniform fee, $117/kg for disposal, and $232/kg for storage plus disposal. The sensitivity cases were grouped in five general categories of variations from the reference case assumptions: demand for storage/disposal services, facility schedules and characteristics, methodology for calculating the fee, discount rate and AFR financing, and delays or failure of the first repository.

56628 (UNI—1072) **Safety analysis report: handling and storage of irradiated N Reactor fuel in 105-kW Fuel Storage Facility.** Moffitt, R.L. (United Nuclear Industries, Inc., Richland, WA (USA)). 5 Jun 1978. Contract EY-76-C-06-1857. 103p. Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

Irradiated N Reactor fuel, which has been cooled for at least 150 days, may be safely stored at the facility in 4.9 meters (16 feet) of water using the storage configuration and will present no undue risk to the health and safety of plant personnel or the general public. The accepted safe storage configuration will prevent an accidental criticality and the water will prevent any significant release of radioactive materials to the environs and limit the radiation exposure in the work area, from the stored fuel, to less than 1 mr/h. The storage configuration consists of full density storage for the lower enriched fuel and half density storage of the spike fuel. The full density storage array will allow for storage of up to 1700 metric tons (1900 tons) of irradiated MK IV fuel while the half density storage array will allow for storage of up to 611 metric tons (660 tons) of irradiated MK IA fuel.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 57563

56629 (LA-UR—78-1652) **Transuranic waste assay instrumentation: new developments and directions at the Los Alamos Scientific Laboratory.** Close, D.A.; Umbarger, C.J.; West, L.; Smith, W.J.; Cates, M.R.; Noel, B.W.; Honey, F.J.; Franks, L.A.; Pigg, J.L.; Trundle, A.S. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780606—16). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

The Los Alamos Scientific Laboratory is developing assay instrumentation for the quantitative analysis of transuranic materials found in bulk solid wastes generated by Department of Energy facilities and by the commercial nuclear power industry. This also includes wastes generated in the decontamination and decommissioning of facilities and wastes generated during burial ground exhumation. The assay instrumentation will have a detection capability for the transuranics of less than 10 nCi of activity per gram of waste whenever practicable.

56630 (PNL—2400) **Nontechnical issues in waste management: ethical, institutional, and political concerns.** Hebert, J.A.; Rankin, W.L.; Brown, P.G.; Schuller, C.R; Smith, R.F.; Goodnight, J.A.; Lippek, H.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 116p. Dep. NTIS, PC A06/MF A01.

The report consists of a presentation and distillation of major nontechnical issues surrounding commercial waste management, fol-

lowed by ethical, institutional, and political analyses of these issues. The ethical analysis consists of a discusson of what is meant by "ethics" and "morality" in the waste management context and an illustrative attempt at an ethical analysis of the commercial nuclear waste problem. Two institutional analyses are presented: one is an analysis of the possible problems of long-term human institutions in waste management; the other is a presentation of institutional arrangements for the short term. A final chapter discusses issues and concerns involving intergovernmental relations—that is, local, state, and federal interface problems in waste management.

56631 (PNL-SA—6707) **Techniques for sampling nuclear waste tank contents and in situ measurement of activity.** Lawrence, R.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1978. Contract EY-76-C-06-1830. 11p. (CONF-781004—1). Dep. NTIS, MF A01.

From Nuclear meeting; Basel, Switzerland (3 Oct 1978). Portions of document are illegible.

A study was conducted to develop suitable sampling equipment and techniques for characterizing the mechanical properties of nuclear wastes; identifying effective means of measuring radiation levels, temperatures, and neutron fluxes in situ in wastes; and developing a waste core sampler. A portable, stainless steel probe was developed which is placed in the tank through a riser. This probe is built for the insertion of instrumentation that can measure the contents of the tank at any level and take temperature, radiation, and neutron activation readings with reliable accuracy. A simple and reliable instrument for the in situ extraction of waste materials ranging from liquid to concrete-like substances was also developed. This portable, stainless steel waste core sampler can remove up to one liter of radioactive waste from tanks for transportation to hot cell laboratories for analysis of hardness, chemical form, and isotopic content. A cask for transporting the waste samples from the tanks to the laboratory under radiation-protected conditions was also fabricated. This cask was designed with a "boot" or inner-seal liner to contain any radioactive wastes that might remain on the outside of the waste core sampling device.

56632 (UCRL—81060) **Measuring social risk and determining its acceptability.** Lathrop, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jul 1978. Contract W-7405-ENG-48. 29p. (CONF-7805113—1). Dep. NTIS, PC A03/MF A01.

From IIASA workshop; Vienna, Austria (2 May 1978).

The implementation of a nuclear waste management technology raises several issues concerning the regulation of social risk. This paper presents a decision analytic approach to resolving some of those issues. A methodology for developing a radiological risk measure is presented, and several approaches to defining acceptable levels of that risk measure are considered. The methodology presented is oriented toward the development of radiological performance objectives for use as guidance in the drafting of regulations.

WASTE PROCESSING

56633 (BNWL-SA—6146) **Properties and characteristics of high-level waste glass.** Ross, W.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 25p. (CONF-770159—1). Dep. NTIS, PC A02/MF A01.

From Properties and characteristics of high-level waste glass; Washington, DC, USA (4 Jan 1977).

This paper has briefly reviewed many of the characteristics and properties of high-level waste glasses. From this review, it can be noted that glass has many desirable properties for solidification of high-level wastes. The most important of these include: (1) its low leach rate; (2) the ability to tolerate large changes in waste composition; (3) the tolerance of anticipated storage temperatures; (4) its low surface area even after thermal shock or impact.

56634 (BNWL-SA—6368) **Electropolishing as a large-scale decontamination technique.** Allen, R.P.; Arrowsmith, H.W.; Budke, W.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 33p. (CONF-771102—25). Dep. NTIS, PC A03/MF A01.

From 20. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

Laboratory-scale studies have shown electropolishing to be a rapid and effective technique for removing plutonium and other radionuclide contamination from a variety of metal surfaces. This paper summarizes work in progress at Battelle, Pacific Northwest Laboratory, to develop electropolishing into a large-scale decontamination technique that can be used to minimize the amount of surface-contaminated metallic waste requiring geologic disposal. A 400-gal. electropolishing facility has been established to develop and demonstrate decontamination techniques for representative plutonium- and beta/gamma-contaminated nuclear industry materials and components. Initial tests using this facility have demonstrated the ability to decontaminate more than 15 sq. ft. of plutonium-contaminated stainless steel in less than 30 min. of electropolishing time. Supporting studies also are in progress to develop in situ electropolishing techniques for the decontamination of surfaces that cannot be transported to or immersed in an electropolishing cell and to develop solution treatment procedures to extend electrolyte life and minimize the amount of secondary waste generated by the decontamination process.

56635 (BNWL-SA—6564) **Technology status of spray calcination—vitrification of high-level liquid waste for full-scale application.** Keeley, R.B.; Bonner, W.F.; Larson, D.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 27p. (CONF-771102—27). Dep. NTIS, PC A03/MF A01.

From 20. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

Spray calcination and vitrification technology for stabilization of high-level nuclear wastes has been developed to the point that initiation of technology transfer to an industrial-sized facility could begin. This report discusses current process and equipment development status together with additional R and D studies and engineering evaluations needed. Preliminary full-scale process and equipment descriptions are presented. Technology application in a full-scale plant would blend three distinct maintenance design philosophies, depending on service life anticipated: (1) totally remote maintenance with limited viewing and handling equipment, (2) totally remote maintenance with extensive viewing and handling equipment, and (3) contact maintenance.

56636 (CONF-780819—14) **Evaluation of the HEPA filter in-place test method in a corrosive off-gas environment.** Murphy, L.P.; Wong, M.A.; Girton, R.C. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). 1978. Contract EY-76-C-07-1540. 11p. Dep. NTIS, MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Portions of document are illegible.

Experiments were performed to determine if the combined effects of temperature, humidity, and oxides of nitrogen (NO/sub x/) hinder the in-place testing of high-efficiency particulate air (HEPA) filters used for cleaning the off-gas from a nuclear waste solidification facility. The laboratory system that was designed to simulate the process off-gas contained two HEPA filters in series with sample ports before each filter and after the filter bank. The system also included a reaction bomb for partial conversion of NO to NO_2. Instrumentation measured stream flow, humidity, NO/sub x/ concentration, and temperature. Comparison measurements of the DOP concentrations were made by a forward light-scattering photometer and a single particle intra-cavity laser particle spectrometer. Experimental conditions could be varied, but maximum system capabilities were 95% relative humidity, 90°C, and 10,000 ppM of NO/sub x/. A 2^3 factorial experimental design was used for the test program. This design determined the main effects of each factor plus the interactions of the factors in combination. The results indicated that water vapor and NO/sub x/ interfere with the conventional photometer measurements. Suggested modifications that include a unique sample dryer are described to correct the interferences. The laser particle spectrometer appears to be an acceptable instrument for measurements under adverse off-gas conditions.

56637 (ICP—1150) **Technical Division quarterly progress report, January 1—March 31, 1978.** Slansky, C.M. (ed.). (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Jul 1978. Contract EY-76-C-07-1540. 139p. Dep. NTIS, PC A07/MF A01.

Fuel Cycle Research and Development: Results are presented on the fluidized-bed calcination of simulated waste from the reprocessing of spent commercial nuclear fuel, on the post-treatment of the resultant calcine, and on the use of bidentate extractants for the separation of actinide elements from the high-level waste prior to calcination. In addition, the development of storage technology for krypton-85 waste, and the behavior of RuO_2 in fluidized-bed combustion of HTGR fuel are reported. Special Materials Production: Reported are the long-term management of defense waste from the ICPP, the chemistry and pilot plant-studies on the removal of actinides and mercury from ICPP first cycle raffinate, the calcined solids retrieval and handling of ICPP waste stored in vaults, and the preparation of environmental impact statements on options given the Defense Waste Document. Process improvements are given on the Fluorinel headend process for zircaloy-clad fuel and on methods for uranium accountability. Other development results reported are on the Rover process for graphite based fuels, on the calcination of sodium-bearing waste, Fluorinel waste, tank WM-183 waste, and electrolytic process waste. Assistance to the Waste Calcination Process Plant is reported as well as support to the New Waste Calcination Process and methods for the monitoring of gaseous effluents. Other Projects Supporting Energy Developments: Results are reported on nuclear materials security, the behavior of liquid-solid fluidized-bed heat exchangers, in-plant reactor source term measurements, burnup methods for fast breeder reactor fuels, absolute ther-

mal fission yields, analytical support to light water breeder reactor development, and species of iodine in the environment. Research on analytical methods cover iodine-129 in calciner feed, computing room improvements, stack gas sampling for particulates, analysis of glassified calcined waste, and specific components in various materials.

56638 (K—1885) **Process gas chromatography for monitoring a rare-gas separation system.** Million, J.G. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

An automatic process gas chromatograph analytical system has been designed for monitoring a pilot plant absorption process used for the separation and concentration of the rare gases krypton and xenon. Chromatographic columns have been developed which allow analysis of a wide variety of gases from simple mixtures of nitrogen, krypton, and refrigerant, to more complex mixtures containing oxygen, nitrogen, refrigerant, carbon dioxide, nitrous oxide, methane, krypton, and xenon.

56639 (MLM—2536(OP)) **Tritium effluent removal system.** Lamberger, P.H.; Gibbs, G.E. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 4p. (CONF-780819—2). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

An air detritiation system has been developed and is in routine use for removing tritium and tritiated compounds from glovebox effluent streams before they are released to the atmosphere. The system is also used, in combination with temporary enclosures, to contain and decontaminate airborne releases resulting from the opening of tritium containment systems during maintenance and repair operations. This detritiation system, which services all the tritium handling areas at Mound Facility, has played an important role in reducing effluents and maintaining them at 2 percent of the level of 8 y ago. The system has a capacity of 1.7 m^3/min and has operated around the clock for several years. A refrigerated in-line filtration system removes water, mercury, or pump oil and other organics from gaseous waste streams. The filtered waste stream is then heated and passed through two different types of oxidizing beds; the resulting tritiated water is collected on molecular sieve dryer beds. Liquids obtained from regenerating the dryers and from the refrigerated filtration system are collected and transferred to a waste solidification and packaging station. Component redundancy and by-pass capabilities ensure uninterrupted system operation during maintenance. When processing capacity is exceeded, an evacuated storage tank of 45 m^3 is automatically opened to the inlet side of the system. The gaseous effluent from the system is monitored for tritium content and recycled or released directly to the stack. The average release is less than 1 Ci/day. The tritium effluent can be reduced by isotopically swamping the tritium; this is accomplished by adding hydrogen prior to the oxidizer beds, or by adding water to the stream between the two final dryer beds.

56640 (MLM—2537(OP)) **Decontamination of HEPA filters.** Koenst, J.W. Jr.; Lewis, E.L.; Luthy, D.F. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 36p. (CONF-780819—1). Dep. NTIS, MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Portions of document are illegible.

Mound Facility, during many years of plutonium-238 experience, has recovered over 150 kg of plutonium-238. Much of this material was recovered from HEPA filters or from solid wastes such as sludge and slag. The objective of this task was to modify and improve the existing nitric acid leaching process used at Mound so that filters from the nuclear fuel cycle could be decontaminated effectively. Various leaching agents were tested to determine their capability for dissolving PuO_2, UO_2, U_3O_8, AmO_2, NpO_2, CmO_2, and ThO_2 in mixtures of the following: HNO_3-HF; HNO_3-HF-H_2SO_4; and HNO_3-$(NH_4)_2Ce(NO_3)_6$. Adsorption isotherms were obtained for two leaching systems. In some tests simulated contaminated HEPA filter material was used, while in others actual spent glovebox filters were used. The maximum decontamination factor of 833 was achieved in the recovery of plutonium-238 from actual filters. The dissolution was accomplished by using a six-stage process with 4N HNO_3-0.23M $(NH_4)_2Ce(NO_3)_6$ as the leaching agent. Thorium oxide was also effectively dissolved from filter media using a mixture of nitric acid and ceric ammonium nitrate. Sodium carbonate and Na_2CO_3-KNO_3 fusion tests were performed using simulated PuO_2-contaminated filter media at various temperatures. Approximately 70 wt% of the PuO_2 was soluble in a mixture composed of 70 wt% Na_2CO_3-30 wt% KNO_3 (heated for 1 h at 950°C). 23 figs., 14 tables.

56641 (MLM—2538) **Development of ultrafiltration and inorganic adsorbents for reducing volumes of low-level and intermediate-level liquid waste, April—June 1978.** Herald, W.R.; Roberts, R.C. (Mound Facility, Miamisburg, OH (USA)). 19 Jul 1978. Contract EY-76-C-04-0053. 16p. Dep. NTIS, PC A02/MF A01.

A series of runs was performed in which waste processing facility influent was spiked with americium-241, neptunium-237, and uranium-233 and run through the ultrafiltration and reverse osmosis (RO) units. The results of these experiments show that the ultrafiltration membranes are ionic dependent, whereas the RO unit is not. Membrane irradiation studies have been started. Continuous run parameters are being verified through a series of experiments. The small laboratory column tests were continued this quarter on several adsorbents. Decontamination factors were calculated for these adsorbents in removing neptunium-237 and americium-241 from waste solutions. Tests were continued with the 2-in. Engineering Columns using ultrafiltration product spiked with uranium-233. A 6-in. diameter column was installed in the combined raffinate line from the three Engineering Columns. This "mixed bed" column will polish the waste solution that is returned to the waste processing facility tanks. A quality control program was started this quarter.

56642 (MLM—2539) **Volume reduction system for solid and liquid TRU waste from the nuclear fuel cycle: April—June 1978.** Alexander, B.M.; Lewis, E.L.; Doty, J.W.; Batchelder, D.H. (Mound Facility, Miamisburg, OH (USA)). 25 Jul 1978. Contract EY-76-C-04-0053. 20p. Dep. NTIS, PC A02/MF A01.

The laboratory cyclone incinerator has been developed to study the effects of burning feed containing radionuclides other than plutonium-238. These isotopes, which will be primarily products of fission, must be efficiently removed from the off-gas if combustible waste containing such species is to be incinerated. Modifications to the original incinerator design were made to increase the efficiency of combustion and particulate removal in the system and to reduce its energy consumption. A drum compactor was purchased, installed, and tested. The test results were as expected; a 55-gal steel drum volume was reduced by 86%. The ash/cement matrix studies were completed. The 65/35 mixture proved to be the best for dry-cure pellets, and the 80/20 mixture produced the best wet-cured pellets. Experimental incinerator ash was successfully sintered; the final carbon content was less than 0.1 wt%.

56643 (RFP—2768) **Disposal of HEPA filters by fluidized bed incineration.** Ziegler, D.L.; Johnson, A.J. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 5p. (CONF-780819—4). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Various methods of gaseous waste immobilization have been tested at the Rocky Flats Plant over the past few years. Vitrification was selected as the most promising immobilization method for wastes collected by high efficiency particulate air filters (HEPA). Two vitrification alternatives were tested, (1) punching out the filter media, feeding it into the vitrification process, and incinerating the frame, and (2) incinerating the entire filter and vitrifying the incinerator residue. It was found that present methods of handling HEPA filters produces a waste probably unacceptable at a permanent repository. HEPA filters can be successfully incinerated using a fluidized bed incinerator. Separation of the frame from the media and incinerating only the frame is an unnecessary operation. The residue from incineration of HEPA filters can be processed into a glass acceptable under proposed repository criteria.

56644 (RHO-SA—38) **Vacuum evaporator-crystallizer process development for Hanford defense waste.** Tanaka, K.H. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Apr 1978. Contract EY-77-C-06-1030. 38p. (CONF-780922—3). Dep. NTIS, PC A03/MF A01.

From ASME conference on power generation; Dallas, TX, USA (10 Sep 1978).

One of the major programs in the Department of Energy (DOE) waste management operations at Hanford is the volume reduction and solidification of Hanford Defense Residual Liquor (HDRL) wastes. These wastes are neutralized radioactive wastes that have been concentrated and stored in single-shell underground tanks. Two production vacuum evaporator-crystallizers were built and are operating to reduce the liquid volume and solidify these wastes. The process involves evaporating water under vacuum and thus concentrating and crystallizing the salt waste. The high caustic residual liquor is composed primarily of nitrate, nitrite, aluminate, and carbonate salts. Past evaporator-crystallizer operation was limited to crystallizing nitrate, nitrite, and carbonate salts. These salts formed a drainable salt cake that was acceptable for storage in the original single-shell tanks. The need for additional volume reduction and further concentration necessitated this process development work. Further concentration forms aluminate salts which pose unique processing problems. The aluminate salts are very fine crystals, non-drainable, and suitable only for storage in new double-shell tanks where the fluid waste can be continuously monitored. A pilot scale vacuum evaporator-crystallizer system was built and operated

by Rockwell Hanford Operations to support flowsheet development for the production evaporator-crystallizers. The process developed was the concentration of residual liquor to form aluminate salts. The pilot plant tests demonstrated that residual liquors with high aluminum concentrations could be concentrated and handled in a vacuum evaporator-crystallizer system. The dense slurry with high solids content and concentrated liquor was successfully pumped in the insulated heated piping system. The most frequent problem encountered in the pilot plant was the failure of mechanical pump seals due to the abrasive slurry..

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 56627, 56628, 56658, 56659, 56662, 56663, 57311

56645 (ANL—78-46) **Migration of long-lived radioactive processing wastes in selected rocks: annual report to the Office of Waste Handling, Project AN0115A, FY 1977.** Fried, S.; Friedman, A.M.; Cohen, D.; Hines, J.J.; Strickert, R.G. (Argonne National Lab., IL (USA)). Apr 1978. Contract W-31-109-ENG-38. 48p. Dep. NTIS, PC A03/MF A01.

Laboratory scale models have been constructed of the Pu—Am disposal areas at Los Alamos Scientific Laboratory and the migration of radionuclides determined. The laboratory model accounted for the extent and characteristics of the Pu migration quite well but did not describe as closely the features of the Am migration, probably owing to the differences in the source terms. Vertical distributions of Pu from the Chalk River Nuclear Laboratory (CRNL) disposal site have been determined on cores of the sandy clay supplied by CRNL. Iodine-129 and technetium-99, nuclides formed in the fission process, would exist as anions; I^-, IO_3^-, and TcO_4^- because of the oxidizing conditions in processing. It was found that the migration of these ions was very little retarded by rocks such as LASL tuff and Salem limestone. On the other hand, selected minerals containing copper and sulfur have been found to react strongly to remove these ions from solution and may be potential "getter" materials for the fixation of these ions. A study of neptunium chemistry has shown that Np(IV) and Np(V) are the most likely oxidation states of this element to exist in ground water. While Np(IV) is easily immobilized because of its extreme insolubility, Np(V) does not bind strongly to many strata. However, it has been shown in this report that minerals containing calcium carbonate or phosphate remove Np(V) from solution in ground waters. Groundwater containing Fe(II) can reduce Np(V) to Np(IV) thus converting it to a relatively immobile species. In the modeling experiments described with I^-, IO_3^-, and TcO_4^- ions as well as in the previous studies with Pu, it has been frequently observed that the distribution of the radioactive materials does not correspond to the gaussian distribution predicted by an equilibrium chromatographic calculation. (14 figures, 8 tables)

56646 (ARH-ST—155) **Hanford environment as related to radioactive waste burial grounds and transuranium waste storage facilities.** Brown, D.J.; Isaacson, R.E. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jun 1977. Contract EY-6-C-06-2130. 130p. Dep. NTIS, PC A07/MF A01.

A detailed characterization of the existing environment at Hanford was provided by the U.S. Energy Research and Development Administration (ERDA) in the Final Environmental Statement, Waste Management Operations, Hanford Reservation, Richland, Washington, December 1975. Abbreviated discussions from that document are presented together with current data, as they pertain to radioactive waste burial grounds and interim transuranic (TRU) waste storage facilities. The discussions and data are presented in sections on geology, hydrology, ecology, and natural phenomena. (JRD)

56647 (HEDL-TME—78-37) **Maximum allowable temperature for storage of spent nuclear reactor fuel. An interim report.** Blackburn, L.D.; Farwick, D.G.; Fields, S.R.; James, L.A.; Moen, R.A. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1978. Contract EY-76-C-14-2170. 79p. Dep. NTIS, PC A05/MF A01.

Evaluations are made as to recommended maximum allowable cladding temperatures of spent nuclear fuels for extended dry storage. A number of near-surface dry storage concepts have been evaluated, as well as concepts for geologic storage. Work is continuing to upgrade and revise maximum temperature evaluations as the program proceeds.

56648 (KBS-TR—30) **Retardation of escaping nuclides from a final depository.** Neretnieks, I. (Kaernbraenslesaekerhet, Stockholm (Sweden)). Sep 1977. 95p. Dep. NTIS (US Sales Only), PC A06/MF A01.

study has been made on retardation of radionuclides in various materials, which could be suited for use in the final repository. A literature survey has shown that except for Cs and Sr very little is known on ion exchange equilibria in ground water surroundings. Measurements were made to determine equilibrium data for Cs, Sr, Eu and U in five natural zeolites, which could be used as filling material. Diffusivities in zeolite particles and bbeds as well as clay beds were also determined. With the aid of these data the function of the ion exchange barrier was investigated. The barrier is so short that the nuclide transport is by diffusion. An 0.2 m barrier of a zeolite will delay Cs and Sr so long that they will decay totally. Am^{241} will also be considerably delayed. An 0.2 m clay-quartz barrier will have very little effect on these nuclides. A 1 m clay-quartz barrier will have about the same effect as an 0.2 m zeolite barrier. Most other nuclides have so long lives that they will only be delayed, but not sufficiently long to decay. The rock itself interacts with many of the radionuclides. A simple model has been made to describe the nuclide retardation and dispersion in fissured rock. With the aid of this, tracer experiments in actual underground rock have been analysed.

56649 (RHO-C—9) **Heat transfer analysis of the high-level waste canister.** Bell, J.M.; Nienberg, J.W.; Seidman, M.H.; Fink, L.C. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). 2 Nov 1977. Contract EY-77-C-06-1030. 120p. Dep. NTIS, PC A06/MF A01.

This report documents the results of a preliminary, two-month study to determine the design constraints imposed by heat transfer considerations on canisters containing solidified, high-level nuclear waste. The waste is derived from the reprocessing of light water reactor fuel for uranium recycle at 160 days after reactor discharge. The study was conducted for Rockwell Hanford Operations in support of their high-level Waste Canister Envelope study. Candidate solidified waste forms considered in this study are in-can melted borosilicate glass and stabilized calcine. Each canister is assumed to be ten feet long, filled with waste to a height of eight feet, and fabricated of 304L stainless steel. Air- and water-cooled interim storage of the canister at the Fuels Reprocessing Plant (FRP) are considered prior to ultimate storage in deep geologic media at Federal repositories. Candidate repository media are salt, shale and basalt. Canister design constraints arise because of the need to maintain the waste forms, canisters, and geologic media below certain critical temperatures. Design constraints, in terms of the maximum allowable canister diameter and heat load, are presented for interim storage at the FRP and for ultimate storage at the repositories. For interim storage, these constraints are presented parametrically in terms of: the time since reprocessing (i.e., the waste age) at which the canister is filled and enters interim storage; the type of cooling used during interim storage; the temperature constraints that may be imposed; and whether or not the canister is overpacked. For geologic storage it is assumed that the canister is overpacked and enters geologic storage ten years after reprocessing. Preliminary conclusions, and recommendations for future analyses, are presented.

56650 (SAND—78-7062) **Existing conditions socioeconomic portion. Waste isolation pilot plant environmental impact report, chapter 2, sections 2.2, 2.3.** (Adcock (Larry) and Associates, Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MF A01.

The population characteristics and the economic setting of Eddy and Lea Counties, New Mexico, are reviewed as related to site selection for a radioactive waste isolation pilot plant. Sections are included on population distribution, basic industries, trade and services, financial resources, personal income, tourism, labor force, employment, land use, water systems, utilities, transportation, and local government. (JRD)

56651 (TREE—1116, pp 229) **Criticality evaluation of overloaded Rocky Flats waste drum.** Fast, E.; Lofthouse, J.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A DOT 17-6 55-gal waste drum received from Rocky Flats in early 1976 was found to be loaded with ^{239}Pu above the limits allowed for storage at the Radioactive Waste Management Complex at Idaho National Engineering Laboratory. A criticality evaluation made to determine if an exception could be made for storing this one overloaded drum on the storage pad with other drums at or below the storage limit showed it would be safe to store the drum with the others.

56652 (TREE—1116, pp 344-351) **Experimental studies for large boxes of transuranic waste.** Mandler, J.W.; Randolph, P.D.; Seymour, L.K. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A laboratory prototype used to evaluate the concept and results in monitoring large waste boxes is described. Two polyethylene slabs holding BF_3 detectors were used to show that adequate

count rates can be obtained. Corrections must be made for the concrete content of the boxes. (FS)

56653 (TREE—1116, pp 352) **Transuranic waste monitor for large drums.** Mandler, J.W.; Randolph, P.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

An assay device is described for monitoring the drums of transuranic waste stored at the Idaho National Engineering Laboratory.

56654 (TREE—1116, pp 353-356) **Calibration of a stabilized assay meter for wastedrum assay.** Randolph, P.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

An Eberline Instrument Corporation "Stabilized Assay Meter" containing two single channel analyzers is evaluated and calibrated for use with 55 gallon waste drums. The instrument used a scintillation detector to count gamma and x-ray radiation. (FS)

56655 (UNI—946) **Radiological characterization of the retired 100 Areas.** Dorian, J.J.; Richards, V.R. (United Nuclear Industries, Inc., Richland, WA (USA)). 26 May 1978. Contract EY-76-C-06-1857. 458p. Dep. NTIS, MF A01.

Portions of document are illegible.

A study was conducted to establish radionuclide inventories and concentrations in the retired 100 Area radioactive solid and liquid waste disposal facilities, leakage areas, reactors, and associated facilities. The data are intended to aid in establishing the long-term disposition and control procedures for these facilities. The purpose of the long-term controls would be to place all facilities in a stable condition such that the possibility of polluting the environs with radioactive material or of affecting the local ecology through radiation exposure is minimized. Adequate short-term control of the contaminated deactivated 100 Area facilities and disposal sites has been established. Maintaining this radiological control requires an ongoing maintenance/surveillance program. Costs associated with this maintenance/surveillance program are expected to increase due to facility deterioration. Future stabilization and/or removal attempts to establish long-term contamination controls will be dependent upon the definition of radiological release criteria for future decommissioning activities at Hanford. Guidance on acceptable levels of surface contamination is provided in AEC Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactor." Only limited guidance has been provided on acceptable activity levels when radionuclides are uniformly distributed in some matrix. Battelle Northwest is establishing radiological release criteria for future decommissioning activities at Hanford as part of the "Disposition of Retired Contaminated Facilities at Hanford" study. Based on dose calculations, radiological release criteria are being derived that will provide long-term public protection from any residual contamination remaining in decontaminated facilities.

56656 (Y/OWI/TM—34) **Nuclear waste projections and source-term data for FY 1977.** Kisner, R.A.; Marshall, J.R.; Turner, D.W.; Vath, J.E. (Union Carbide Corp., Oak Ridge, TN (USA). Office of Waste Isolation). 26 Apr 1978. Contract W-7405-ENG-26. 88p. Dep. NTIS, PC A05/MF A01.

A description of the light-water reactor (LWR) fuel cycle and the nature of the radioactive wastes is basic to the design and evaluation of terminal waste repositories. For these projections, the fuel cycle is represented as a typical system of operations related to the back end of the LWR fuel cycle. Wastes, as prepared for disposal, are described in terms of form, volume, radioactivity, heat generation, and weight. To obtain these waste projections, three fuel management computer codes were used: ORIGEN, KWIKPLAN, and WASPR. A brief description of these codes and their usage is included. Also included are descriptions of the containers assumed to be used for the handling and geologic disposal of the various waste types. The data generated for the Office of Waste Isolation (OWI) and its subcontractors are documented. Projections of LWR fuel cycle wastes are based on OWI modification of the ERDA mid-case forecast of 1976 for nuclear power growth in the United States. In this case, the installed nuclear electric capacity rises from a nominal 50 GW(e) in year 1977 to a nominal 480 GW(e) in the year 2000. The power reactor grid is assumed to consist entirely of LWRs. The four basic fuel cycle scenarios considered follow the same growth curve. These fuel cycles range from spent unreprocessed fuel (SURF) through full recycle of both uranium and plutonium. The overall objective is to compare the impacts of the alternative fuel cycles rather than to describe the impacts of reactor growth scenarios or the use of raw materials for power generation.

56657 (Y/OWI/TM—44) **Contribution to draft generic environmental impact statement on commercial waste management: radioactive waste isolation in geologic formations.** (Union Carbide Corp., Oak Ridge, TN (USA). Office of Waste Isolation). Apr 1978. Contract W-7405-ENG-26. 455p. Dep. NTIS, PC A20/MF A01.

This document concentrates on deep geologic isolation of wastes in bedded salt, granite, shale, and basalt with emphasis on wastes from three fuel cycles: reprocessing wastes from uranium and plutonium recycling, reprocessing wastes from uranium-only recycling, and spent unreprocessed fuel with no recycling. The analyses presented in this document are based on preconceptual repository designs. As the repository designs progress through future phases, refinements will occur which might modify some of these results. The 12 sections in the report are: introduction; selection and description of generic repository sites; LWR wastes to be isolated in geologic formations; description of waste isolation facilities; effluents from the waste isolation facility; assessment of environment impacts for various geographical locations of a waste isolation facility; environmental monitoring; decommissioning; mine decommissioning site restoration; deep geologic alternative actions; potential mechanisms of containment failure; and considerations relevant to provisional versus final storage.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 56626, 56640, 56645, 56655, 56663, 57534

56658 (BNL-NUREG—50739) **Evaluation of isotope migration: land burial. Water chemistry at commerically operated low-level radioactive waste disposal sites. Progress report No. 5, April—June 1977.** Colombo, P.; Weiss, A.J.; Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Oct 1977. EY-76-C-02-0016. 45p. Dep. NTIS, PC A02/MF A01.

Water samples were collected from ten trenches at the Maxey Flats (Morehead) Kentucky, low-level radioactive waste disposal site and analyzed for the presence of organic compounds. Identification of the organics was achieved by combined gas chromatography—mass spectrometry. Alcohols, aliphatic and aromatic acids, phthalates, adipates, and tributyl phosphate are the predominant kinds of compounds found in most of the trench water samples. These organic compounds may react with the radionuclides buried in the trenches and possibly affect their mobility in the environment.

56659 (EMD—78-90) **Uranium mill tailings cleanup: Federal leadership at last.** (General Accounting Office, Washington, DC (USA)). 20 Jun 1978. 54p. General Accounting Office, Washington, DC.

The Department of Energy has proposed legislation that would allow it to enter into cooperative agreements with various States to clean up residual radioactive materials--commonly called uranium mill tailings--at 22 inactive uranium mills. About 25 million tons of mill tailings have accumulated at these sites since the 1940s. GAO analyzed the need for, and adequacy of, the proposed legislation and recommends that the cleanup program be endorsed. While the Federal Government has no apparent legal responsibility for such a cleanup, it does have a moral responsibility since the mills primarily produced uranium for Federal programs. Further, it is the only organization able to undertake such a cleanup program on a comprehensive basis. GAO also suggests several areas where the proposed legislation could be strengthened.

56660 (ORNL/TM—6520) **Preliminary draft: environmental impact statement for Hot Engineering Test Project at Oak Ridge National Laboratory.** Boyle, J.W.; Baxter, B.J.; Carpenter, J.A. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 163p. Dep. NTIS, PC A08/MF A01.

The project considered is the Hot Engineering Test Project (HETP), which is to be located in largely existing facilities at Oak Ridge National Laboratory (ORNL). The project is a part of the National High Temperature Gas-Cooled Reactor Fuel Recycle Program, which seeks to demonstrate the technological feasibility of the recycle processes. The HETP will attempt to confirm the operability of the processes (proven feasible in cold or nonradioactive, benchtop experimentation) under the more realistic radioactive condition. As such, the operation will involve the reprocessing and refabrication of spent HTGR fuel rods obtained from the Fort St. Vrain reactor. The reference fuel is highly enriched uranium. No significant radiological impacts are expected from routine operation of the facility to any biota or ecosystem. Concentrations of one or more radionuclides in Whiteoak Lake will increase as a result of the combination of HETP wastes with other ORNL wastes. Nonradiological effects from construction activities and routine operation should be insignificant on land and water use and on terrestrial and aquatic ecosystems. No significant socioeconomic impacts should occur from either construction or operation of the facility. Some conservative accident scenarios depict significant releases of radioactivity. Effects should be localized and would not be severe for all but the most unlikely of such incidents. No significant long-term commitment of resources is expected to be required for the project. Nor are any large quantities

of scarce or critical resources likely to be irreversibly or irretrievably committed to the project. Principal alternatives considered were: relocation of the project site, postponement of the project schedule, project cancellation, and chemical process variations.

56661 (PNL—2415) **Environmental assessment strategies in support of the Nonproliferation alternative systems assessment program (NASAP).** Emery, R.M.; Warner, M.L.; Meyer, H.R.; Little, C.A.; Till, J.E. (Battelle Pacific Northwest Labs., Richland, WA (USA); Oak Ridge National Lab., TN (USA)). Oct 1977. Contract EY-76-C-06-1830. 40p. Dep. NTIS, PC A03/MF A01.

The U.S. Department of Energy (DOE) is currently conducting a Nonproliferation Alternative Systems Assessment Program (NASAP) to identify nuclear fuel cycle options that pose inherently low risks of nuclear weapons proliferation while retaining the major benefits of nuclear energy. During FY 1978, the desirability and effectiveness of alternative nuclear fuel cycles will be examined in terms of the cycles' proliferation risk, technical feasibility, economic feasibility, and potential environmental and health effects. Final recommendations based on these several assessments may be made late in FY 1978. Carefully planned, highly efficient research strategies will be required to complete the necessary assessments within the anticipated time frame. The purpose of this report is to identify and evaluate alternative strategies for organizing the environmental and health (E and H) effects assessment. Following a brief review of the range of alternative nuclear fuel cycles under consideration, the report consists of three major sections. A discussion of what presently appear to be the most significant environmental and health issues associated with alternative fuel cycles is presented in Section 2. Major choice points in developing an effective assessment strategy, and the range of options available at each, are identified and evaluated in Section 3. Section 4 summarizes conclusions and recommends courses of action for proceeding with the detailed NASAP environmental assessment.

56662 (TREE—1116, pp 339-343) **Technical feasibility studies of bulk soil monitoring for transuranic contamination At 10 nCi/9.** Mandler, J.W.; Randolph, P.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A multiple detector array with continuously sampling soils contaminated with 5-nCi/g of plutonium-239 plus americium-241 (and nothing else) can be assayed on a high (about 1 yr/hr) throughput basis. Presence of gamma-ray emitters other than plutonium-239 and americium-241 will tend to decrease the ability to assay at the 10-nCi/gm level. (FS)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 56622, 56623, 56626, 56651, 57309

56663 (BNWL-SA—6121) **Health physics aspects of waste management.** Unruh, C.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1977. Contract EY-76-C-06-1830. 12p. (CONF-770720—14). Dep. NTIS, PC A02/MF A01.

From 22. annual meeting of the Health Physics Society; Atlanta, GA, USA (3 Jul 1977).

Radioactive waste is encountered at every step of the LWR fuel cycle, and health physics is needed in the management of these wastes. Environmental surveillance will be needed. Health physics analysis supports the program to put radioactive waste in deep geologic isolation. The role of the health physicist in public interaction and communications is discussed. (DLC)

56664 **Manual on radiological safety in uranium and thorium mines and mills.** *Saf. Ser., Int. At. Energy Agency;* No. 43, vp(1976).

This manual describes the significant radiological hazards in uranium and thorium mines and mills and the current techniques of monitoring and control. The reliability and completeness of the techniques, especially with regard to monitoring, are quite variable because some are new and relatively untried. In fact, for some types of measurement, certain methods are merely suggested, never having been tested in actual working environments. This lack of practical field experience is more pronounced in the case of techniques for thorium mines and mills which are so few in number. But in all cases, an effort has been made to describe the best available technology and to indicate the degree of confidence with which the techniques may be used. 55 refs.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 56621, 56661, 57071

56665 (DOE/DP—0006) **Technical evaluation of Tom Scurry Associates: Model PM-203 doorway monitor.** (Department of Energy, Washington, DC (USA). Office of Safeguards and Security). Jul 1978. 20p. Dep. NTIS, PC A02/MF A01.

Under a basic assignment by the Office of Safeguards and Security, the Tom Scurry Associates Model PM-203 Personnel Doorway SNM Monitor manufactured by Tom Scurry Associates was evaluated by LASL Group Q-2 against the DOE Personnel Doorway Monitor standards. During the evaluation, a small change was required in detector shielding to eliminate low sensitivity areas at the portal sides. With the modified shielding described, the PM-203 meets the Office of Safeguards and Security SNM doorway monitor specifications for detecting either ^{235}U or ^{239}Pu—^{233}U. This system is also capable of monitoring ^{238}Pu.

56666 (HCP/W1830—01) **DOE assessment guide for safeguards and security.** Bennett, C.A.; Christorpherson, W.E.; Clark, R.J.; Martin, F.; Hodges, Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1978. Contract EY-76-C-06-1830. 56p. Dep. NTIS, PC A04/MF A01.

DOE operations are periodically assessed to assure that special nuclear material, restricted data, and other classified information and DOE facilities are executed toward continuing the effectiveness of the International Atomic Energy Agency safeguards. A guide to describe the philosophy and mechanisms through which these assessments are conducted is presented. The assessment program is concerned with all contractor, field office, and Headquarters activities which are designed to assure that safeguards and security objectives are reached by contractors at DOE facilities and operations. The guide takes into account the interlocking relationship between many of the elements of an effective safeguards and security program. Personnel clearance programs are a part of protecting classified information as well as nuclear materials. Barriers that prevent or limit access may contribute to preventing theft of government property as well as protecting against sabotage. Procedures for control and surveillance need to be integrated with both information systems and procedures for mass balance accounting. Wherever possible, assessment procedures have been designed to perform integrated inspection, evaluation, and follow-up for the safeguards and security program.

56667 (LA—7337-MS) **Structure of safeguards systems.** Shipley, J.P. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

An effective safeguards system for domestic nuclear fuel cycle facilities consists of several important subsystems that must coordinate their functions with plant management and process control. The safeguards system must not unnecessarily disrupt plant operations, compromise safety requirements, or infringe on employee working conditions. This report describes concepts, which have been developed with the cooperation of the nuclear industry and the safeguards community, for achieving these objectives.

56668 (NUREG/CR—0228) **Physical protection of nuclear material in-transit. Quarterly report, October—December 1977.** Rinne, R.L. (Sandia Labs., Livermore, CA (USA)). Jul 1978. Contract EY-76-C-04-0789. 22p. (SAND—78-8242). Dep. NTIS, PC A02/MF A01.

During the Fall quarter, the principal simulation models for physical protection systems—SOURCE and SABRES—were developed and used to assess the security provided by various convoy configurations. Presentations were made on these and other methodologies, including a model for analyzing the availability of local law-enforcement officers (COPS), a barrier penetration model (BARS), and a road-transit combat game (AMBUSH). Significant developments are described in the following task areas: convoy configuration analysis, communications analysis, response force analysis, conflict analysis, barrier penetration analysis, weapons effects data base, and transportation network simulation.

56669 (SAND—77-0777) **Barrier technology handbook.** (Sandia Labs., Albuquerque, NM (USA)). Apr 1978. Contract EY-76-C-04-0789. 342p. Dep. NTIS, PC A15/MF A01.

As part of its program in developing safeguards technology that can be applied to existing DOE facilities and facilities in the design stage, a handbook is presented on fixed facility physical protection. It is intended as a working document to provide general barrier system philosophy. It provides a central source of barrier penetration times for evaluation of the effectiveness of physical protection systems. It will aid designers in the selection of cost-effective barriers. Descriptions are given of concepts for upgrading existing barriers and advanced concepts for new or replacement barriers. The topics discussed are: the role of barriers, perimeter barriers, walls, roofs and floors, doors, locking mechanisms, windows, utility posts, vaults, igloos, earth cover and overburden, airborne penetration deterrents, armor, disposable barriers and deterrents, and penetration times and rates. (JSR)

56670 (SAND—78-1594C) **Containment and surveillance devices.** Campbell, J.W.; Johnson, C.S.; Stieff, L.R. (Sandia Labs., Albuquerque, NM (USA)). [nd]. Contract EY-76-C-04-0789. 9p. (CONF-781007—4). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

The growing acceptance of containment and surveillance as a means to increase safeguards effectiveness has provided impetus to the development of improved surveillance and containment devices. Five recently developed devices are described. The devices include one photographic and two television surveillance systems and two high security seals that can be verified while installed.

56671 (SAND—78-1628C) **Preliminary concepts for detecting diversion of LWR spent fuel.** Sellers, T.A. (Sandia Labs., Albuquerque, NM (USA)). [nd]. Contract EY-76-C-04-0789. 14p. (CONF-781007—2). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Sandia Laboratories, under the sponsorship of the Department of Energy, Office of Safeguards and Security, has been developing conceptual designs of advanced systems to rapidly detect diversion of LWR spent fuel. Three detection options have been identified and compared on the basis of timeliness of detection and cost. Option 1 is based upon inspectors visiting each facility on a periodic basis to obtain and review data acquired by surveillance instruments and to verify the inventory. Option 2 is based upon continuous inspector presence, aided by surveillance instruments. Option 3 is based upon the collection of data from surveillance instruments with periodic readout either at the facility or at a remote central monitoring and display module and occasional inspection. Surveillance instruments are included in each option to assure a sufficiently high probability of detection. An analysis technique with an example logic tree that was used to identify performance requirements is described. A conceptual design has been developed for Option 3 and the essential hardware elements are not being developed. These elements include radiation, crane and pool acoustic sensors, a Data Collection Module, a Local Collection Module, a Local Display Module and a Central Monitoring and Display Module. A demonstration, in operating facilities, of the overall system concept is planned for the March to June 1979 time frame.

56672 (TREE—1116, pp 357-358) **NRC special safeguards study.** Vegors, S.H.; Mandler, J.W.; Nieschmidt, E.B.; Randolph, P.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

The purpose of this study was to obtain background information on the highly enriched uranium fuel cycle for the Nuclear Regulatory Commission so that this information could be used in a generic environmental impact statement. The main areas of investigation are listed. A brief summary of some of the general conclusions of this study is given. (LK)

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 57057

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

56673 (UCRL—79735(Rev.1)) **Low aspect ratio double shell targets for high density and high gain and a comparison with ultra thin shells.** Lindl, J.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Sep 1977. Contract W-7405-ENG-48. 17p. (CONF-771136—33). Dep. NTIS, PC A02/MF A01.

From Annual American Physical Society meeting; Atlanta, GA, USA (7 Nov 1977).

Double shell targets may have decisive advantages over single shells for achieving a number of goals in the laser fusion program. With 0.2 μ light, such designs achieve 500 to 1000 times liquid density at 2 kJ absorbed; 10 percent or more of breakeven at 15 kJ absorbed, and gains of 10 or more at 200 kJ absorbed. These targets are relatively insensitive to preheat, laser pulse shape, and hydrodynamic instability. A double shell in which the outer pusher is fuel may achieve a gain of 1000 for lasers in the 1 to 10 megajoule size. Ultra thin targets have only about a factor of two reduction in power shells with aspect ratios of 2 to 4 while requiring about the same input energy and achieving about the same gain. Their extreme sensitivity to preheat, symmetry, and hydrodynamic instability makes them unattractive for targets in advanced lasers systems.

56674 **High thermonuclear energy gains with a low tritium inventory for inertially confined fusion.** Skupsky, S. (Rochester Univ., N.Y. (USA)). *Nucl. Fusion;* **18**: No. 6, 843-848(1978).

Calculations were performed to investigate how the thermonuclear energy gain for inertially confined fusion varies as a function of the tritium inventory. Results showed that for large rhoR pellets ($25 g/cm^2$) the yield was relatively insensitive to the D:T ratio, so that a reduction by a factor of five in the amount of tritium produced only a 15% reduction in yield. An attempt was made to further reduce the sensitivity by replacing some of the deuterium by ^6Li. The idea was to breed tritium by neutron capture within the pellet and then to burn it in situ. However, the breeding rate was found to be too slow for this process to make any significant contribution to the burn. Lithium was not able to improve upon deuterium as a fuel.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 58077

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 57502

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 56406

ISOTOPIC POWER SUPPLIES

56675 (BMI-X—694) **Report on goals of RTG impact member research.** Duckworth, W.H. (Battelle Columbus Labs., OH (USA)). May 1978. Contract W-7405-ENG-92-094. 12p. Dep. NTIS, PC A02/MF A01.

During recent years, Battelle has been engaged in research on impact members of radioisotope thermal generators (RTGs) for space use. Emphasis in the research to date has been on developing a materials technology. This effort has now reached a stage where consideration can be given to engineering measures for assessing and upgrading the performance of impact members in RTGs of current interest, including particularly General Electric Company's Multi-Hundred Watt (MHW) RTG and the General Purpose Heat Source (GPHS) being developed by Los Alamos Scientific Laboratory. New research goals have been set accordingly. The purpose of the report is to present these goals, give the rationale for them, and indicate the research approaches for meeting them.

DESIGN AND FABRICATION

56676 (BMI-X—696) **Heat source component development program. Report for period March 1978—June 1978.** (Connecticut Yankee Atomic Power Co., East Hampton (USA)). Jul 1978. Contract W-7405-ENG-92-094. 66p. Dep. NTIS, MF A01.

Portions of document are illegible.

The General Purpose Heat Source (GPHS) is a radioisotope heat source being developed by LASL. The first intended application for the GPHS is the Solar Polar mission scheduled for 1983. Battelle's support of LASL during the current reporting period is reported. The specific efforts include: (1) analysis of trial designs with emphasis on comparison of performances of trial designs 1 and 2 and their modifications; and (2) helium vent development with emphasis on fabrication and qualification testing of platinum and iridium nonselective vents. (TFD)

HYDROGEN

PRODUCTION

ELECTROLYSIS

REFER ALSO TO CITATION(S) 56710

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 58077

WATER GAS PROCESSES

56677 Homogeneous catalysis of the water gas shift reaction by mixed-metal (iron/ruthenium) catalysts. Ford, P.C.; Rinker, R.G.; Ungermann, C.; Laine, R.M.; Landis, V.; Moya, S.A. (Univ. of California, Santa Barbara). *J. Am. Chem. Soc.;* **100**: No. 14, 4595-4597(5 Jul 1978).

For the water gas shift reaction $H_2O + CO \rightarrow CO_2 + H_2$, homogeneous catalysts may be prepared from ruthenium carbonyl. Mixed Ru/Fe carbonyl catalysts are more active in basic solutions than either one of these carbonyls alone. Activities of those and other carbonyl catalysts are tabulated. The mechanism of the catalytic effect is discussed. (DLC)

56678 Water gas shift process. Segura, M.A.; Aldridge, C.L.; Riley, K.L.; Pine, L.A. (to Exxon Research and Engineering Co.). US Patent 4,054,644. 18 Oct 1977. Filed date 25 Nov 1974. 10p.

Hydrogen is produced by reacting carbon monoxide with steam at a temperature of at least 200°F in the presence of a supported catalyst containing: (1) at least one alkali metal compound derived from an acid having an ionization constant below 1×10^{-3}, (2) a metallic hydrogenation- dehydrogenation material, and (3) a halogen moiety. The ratio of metal component to alkali metal compound, each calculated on the basis of the oxide thereof, ranges from 0.0001 to about 10 parts by weight per part by weight of the alkali metal compound. The halide constituent is present in amounts in excess of about 0.01 weight percent, based on total catalyst. A preferred catalyst composition comprises potassium carbonate, a mixture of cobalt and molybdenum oxides and combined chlorine contained on an alumina support.

STEAM-IRON PROCESS

REFER ALSO TO CITATION(S) 56335

STORAGE

CHEMISORPTION

56679 Quaternary metal hydride. Reilly, J.J.; Wiswall, R.H. US Patent Application 729,640. 5 Oct 1976. 5p.

A three component alloy capable of reversible sorption of hydrogen is claimed. The alloy has the chemical formula TiFe/sub x/R/sub y/, where R is a metal selected from the group consisting of Cu, Mo, Ni, V, Co, and Cr; and x is a number in the range of 0.1 to 1; and y is a number in the range of 0.05 to 1. The method of storing hydrogen using said alloy is described.

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 56332

56680 Heterogeneous photocatalytic synthesis of methane from acetic acid: new Kolbe reaction pathway. Kraeutler, B.; Bard, A.J. (Univ. of Texas, Austin). *J. Am. Chem. Soc.;* **100**: No. 7, 2239-2240(29 Mar 1978).

The heterogeneous photocatalytic decomposition of acetic acid on n-type TiO_2 to yield almost exclusively methane and carbon dioxide is reported. Probable reaction mechanisms are discussed. It is assumed that the TiO_2 powder acts in a dual function causing the photooxidation of acetate and the reduction of intermediately formed methyl radicals. This property is not found at metal electrodes under usual Kolbe conditions. (JSR)

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 56702, 56703, 56705

56681 (CONF-780340—) Proceedings of a symposium on the utilization of methane generated in landfills. (Department of Energy, Washington, DC (USA). Office of Building and Community Systems). 1978. Contract EM-78-G-01-4206. 34p. Dep. NTIS, PC A03/MF A01.

From Conference on utilization of methane generating in land fills; Laurel, MD, USA (9 Mar 1978).

Summaries of papers presented and the conclusions and recommendations of workshops on the utilization of landfill methane are compiled. Past and present experiences in the production of landfill methane in California, New York, and Colorado are summarized. Technical and institutional factors related to the use of landfill methane were identified. The symposium participants concluded that the technology is viable. The problems identified in implementation included technology transfer, decision-making on the part of local government as to its appropriateness, optimization of recovery, little correlation between laboratory tests and field experiences, design of gas gathering systems, overall landfill design and siting, regulatory restrictions, financing mechanisms, information transfer, and uncertainties on gas ownership and legal liabilities. (JSR)

56682 Methane production from wastes. Rasch, R. *Int. Chem. Eng.;* **18**: No. 3, 402-407(Jul 1978).

Translated from Chem. Ing. Tech.; 49: No. 1, 25-30(1977).

Methane results from both biological and thermal decomposition of wastes. Methane is currently produced incompletely in deposits of refuse, or in closed, heated vessels from wet organic wastes. Thermal processes (degassing and gasification), are still under development, and may be of interest only in special cases, since the quantities of refuse available are usually too small to permit economic large scale gas production.

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 56589

56683 Large-scale methanol plants. Tado, Y. *Tech. Rev., Mitsubishi Heavy Ind.;* **15**: No. 1, 11-17(Feb 1978).

A study was made on how to produce methanol economically which is expected as a growth item for use as a material for pollution-free energy or for chemical use, centering on the following subjects: (1) Improvement of thermal economy, (2) Improvement of process, and (3) Problems of hardware attending the expansion of scale. The results of this study were already adopted in actual plants, obtaining good results, and large-scale methanol plants are going to be realized.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 56702, 56703

INORGANIC HYDROGEN COMPOUND FUELS

REFER ALSO TO CITATION(S) 56703

PREPARATION

REFER ALSO TO CITATION(S) 56358

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 56702, 57500

HYDRO ENERGY

REFER ALSO TO CITATION(S) 56881, 56882, 56886

56684 Symposium on the Grand Coulee Dam Third Power Plant: construction. Mueller, R.J. (Bureau of Reclamation, Grand Coulee, WA). *Proc. Am. Power Conf.;* **39**: 957-962(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The construction activities for the Grande Coulee Third Power Plant from 1967 to 1975 are discussed. (LCL)

RESOURCES AND AVAILABILITY

56685 Symposium on the Grand Coulee Dam Third Power Plant: planning the Third Power Plant. Moore, N.H. (Bureau of Reclamation, Boise, ID). *Proc. Am. Power Conf.;* **39**: 943-953(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The feasibility and planning studies which have been in progress since 1951 to determine whether a 3900 MW third power plant should be added to the Grande Coulee Dam complex are described. (LCL)

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 56686, 57104

PLANT DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 56685

56686 Geology and environment dictate dam design. Hollingworth, F. *Int. Water Power Dam Constr.;* **30**: No. 6, 48-52(Jun 1978).

The Blyderivierspoort dam is a 71 m, high arch-gravity structure, situated in one of the most beautiful parts of South Africa; consequently the design of the dam, as well as the location of the access roads and aggregate sources, has been very much influenced by the requirement to preserve the environment. One problem which arose was the heterogeneous nature of the geology, implying a rather suspect foundation condition for a concrete dam. A discussion is given of water resources, dam site geology, dam design, spillways and outlets, construction, and instrumentation.

56687 Reducing drag by polymers for hydro construction. Maksimovic, C. (Univ., Belgrade). *Int. Water Power Dam Constr.;* **30**: No. 6, 53-58(Jun 1978).

A very low concentration of polymer additives can cause a dramatic change in energy losses in fluid flow. It is possible therefore to apply these drag reducing additives to increase the capacity of discharge structures in which friction energy losses can play an important role. A diversion tunnel is chosen as an example. Topics discussed include: (1) effect of polymers on the friction factor, (2) increasing tunnel discharge capacity, (3) economic aspects, and (4) other applications.

56688 Stresses in substructure of a surface hydro powerhouse. Datta, R. (Univ. of Roorkee, India); Dandekar, Y.S. *J. Inst. Eng. (India), Civ. Eng. Div.;* **58**: 169-180(Jan 1978).

The substructure of a surface hydro power station is a monolithic gravity structure, but it has to accommodate various irregular cavities and hollows of appreciable volume. Incidence of loads is also peculiar and eccentric, some of them occurring within the mass of the block. Therefore, stress determination in such a structure is very complex. An analysis of stresses on account of self-weight and machine loads is attempted using two-dimensional finite element method. In any power house, these loads would be the dominant—self weight accounting for about 90 percent of all the loads and machine loads of about 5 to 6 percent. The results suggest that stresses are generally of very low order. Some stress concentration around the openings is confined to the immediate proximity of the boundaries of even the large cavities for which only nominal reinforcement for crack prevention is necessary.

56689 Symposium on Grand Coulee Dam Third Power Plant: special design problems. Stevenson, W.C. (Dept. of Interior, Denver). *Proc. Am. Power Conf.;* **39**: 953-957(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Special design problems related to the dam extension, the waterway, intakes, penstocks, the six turbogenerators, and the power plant structure for the hugh Grand Coulee Third power plant are disussed. (LCL)

56690 Symposium on the Grand Coulee Dam Third Power Plant: operation. Mueller, R.J. (Bureau of Reclamation, Grand Coulee, WA). *Proc. Am. Power Conf.;* **39**: 963-968(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The operation of the Grande Coulee Third Power Plant, begun in Oct. 1975, and the control systems used for automation are discussed. (LCL)

56691 Symposium on the Grand Coulee Dam Third Power Plant: turbines. Allan, R.S. (Dominion Engineering Works Ltd., Montreal). *Proc. Am. Power Conf.;* **39**: 968-970(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Some of the design, fabrication and testing problems encountered with the giant hydraulic turbines ordered for the Third Power Plant at Grand Coulee Dam are briefly described. These turbines rated at 820,000 hp under a head of 285 ft. were approximately double the size of turbines being built in 1968. After one year of operation the three turbines are operating at predicted performance levels. (LCL)

56692 Symposium on the Grand Coulee Dam Third Power Plant: 820,000-horsepower hydraulic turbines. Nieswander, P.S. (Bingham-Willamette Co., Portland, OR). *Proc. Am. Power Conf.;* **39**: 970-975(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The overall management of the turbine contract for the Grand Coulee Third Power Plant is discussed. This contract called for the design, model testing, manufacture, delivery and installation of three 820,000-hp hydraulic turbines. The major problems to be overcome in this contract, e.g., tight scheduling, divided manufacture, size scale of components, shipping regulations, and the successful completion of each task are discussed. The 59,000 parts were delivered undamaged and installed in less time than required by contract. The 3 turbines are on line operating satisfactorily and have an indicated full gate capability of 1,000,000 hp each surpassing all existing hydraulic turbines worldwide. (LCL)

56693 Symposium on the Grand Coulee Dam Third Power Plant: the 700-MW turbines. Fishcer, J.H. (Allis-Chalmers Corp., York, PA). *Proc. Am. Power Conf.;* **39**: 975-985(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design, manufacture and installation of the three 700-MW hydraulic turbines for the Grand Coulee Dam are discussed. The planned commercial operation date for the first unit was Sept. 1977. (LCL)

56694 Symposium on the Grand Coulee Dam Third Power Plant: generators—Units 22, 23, and 24. Parker, D.J. (Canadian General Electric Co. Ltd., Peterborough, Ont.). *Proc. Am. Power Conf.;* **39**: 986-992(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The electrical and mechanical design features of the three electric generators for the Grand Coulee Third Power Plant are discussed. Each of these generators has a rated output of 700 MW at an operating speed of 85.7 rpm. The stator winding in these generators is water-cooled. All other components are air-cooled. (LCL)

56695 Gas-insulated switchgear solves difficult problems at hydroelectric plants. Cooper, E.A.; Nikolas, J.T. (Harza Engineering Co., Chicago). *Proc. Am. Power Conf.;* **39**: 1295-1303(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Factors which influence the application of gas-insulated switchgear to hydroelectric projects of both the conventional and pumped-storage type are discussed, and some planned installations are described. It is illustrated that gas-insulated HV and EHV switchgear can be used advantageously on large hydroelectric projects where site conditions makes the application of conventional, outdoor, air-insulated switchgear very difficult. The gas-insulated switchgear can be placed on a deck or roof of the powerhouse structure if the powerhouse is above ground, thus making possible relatively short instrument transformer and control leads, and eliminating the space and other problems attending a conventional switchyard. Several possible arrangements for gas-insulated switch gear for power houses located in underground caverns are also described. (LCL)

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 57104

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 56686

SOLAR ENERGY

REFER ALSO TO CITATION(S) 56882, 57107

56696 (AD-A—049490) **Survey of considerations for solar energy facility applications. Final report.** Nay, M.W. Jr. (Civil and Environmental Engineering Development Office, Tyndall AFB, FL (USA). Detachment 1 (ADTC)). Dec 1977. 65p. (CEEDO-TR—77-39). NTIS PC A04/MF A01.

The purpose of this report is to provide Air Force civil engineers some useful information for the planning and programming of solar energy systems to satisfy facility energy requirements. This report has been prepared in response to the belief that considerable interest in solar energy system technology, as well as other alternate energy schemes, is increasing at a rapid pace in the Air Force. A considerable effort is devoted to appraising the current status of fossil fuel energy resources in order to establish the need for expanded work in developing solar energy technology. The current and potential areas of application of solar energy technology are described with special attention devoted to space heating. Additionally, environmental considerations of solar energy technology are described along with the current Air Force solar energy program. This report concludes with some suggestions for establishing a solar energy program on an individual or installation basis.

56697 (CONF-7706130—, pp 32p, Session 5, Paper 1) **Solar energy advanced designs.** Coleman, H.S. (Energy Research and Development Administration, Washington, DC). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The ERDA solar energy program is briefly reviewed; included are direct thermal, thermal power, photovoltaics, wind electrical conversion, biomass, ocean thermal electrical conversion, and solar power satellites. (WHK)

ECONOMICS

REFER ALSO TO CITATION(S) 56706, 56709, 56714, 56725, 56726, 56729, 56732, 57097

56698 (MTR—7485(App.)(Vol.1)) **Systems descriptions and engineering costs for solar-related technologies. Appendix to Volume I. Experience curves and cost trends: a preliminary consideration of some factors likely to influence capital costs in selected solar energy systems.** Gadsby, G.N. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 130p. Dep. NTIS, PC A07/MF A01.

This Appendix to MITRE/METREK Report MTR-7485 ("System Descriptions and Engineering Costs for Solar-Related Technologies, Volume I") presents the findings of a limited study of experience curve and cost trend histories within a wide range of commodities relevant to projected solar energy system concepts. Two forms of data presentation are used: (1) experience curves derived from production volume and unit cost inputs and (2) cost trend curves where data on accumulated production volumes are not readily available. Although many years of historical data have been assembled, it has seldom been possible to acquire those relating to the onset of production. However, in the context of the objective of this Appendix, cost tends in relatively recent—say, ten to twenty--years are the more important consideration. Bearing in mind that projected solar energy systems will comprise elements of conventional plant equipment, materials, construction, etc., as well as those unique to such systems, experience curve and/or cost trend histories are presented with respect to the following categories; (1) buildings and structures; (2) construction of complete plant (petroleum refining and processing and electric power generation); (3) component plants and equipments; (4) electric power transmission and distribution; (5) materials; (6) instrumentation and electronics; (7) oceangoing tankers (relevant to OTEC); (8) forest and agricultural products (relevant to biomass); (9) ancillary equipments; (10) labor; and (11) energy. (WHK)

56699 (MTR—7485(Vol.1)) **Systems descriptions and engineering costs for solar-related technologies. Volume I. Summary.** (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 157p. Dep. NTIS, PC A08/MF A01.

The results of the METREK solar energy engineering cost study, in support of the System to Project Utilization of Renewable Resources (SPURR) model, are presented. Generic systems designs are formulated and the associated engineering costs are evaluated and estimated. An aim of this study is to predict the likely costs and performance of solar equipment, once mass produced. The data have been summarized on generic design data forms and are presented. The systems are grouped into four major categories by application type: (1) electric utility applications, (2) solar heating and cooling of buildings (SHAdesigns,nment contractorsOB), (3) agricultural and industrial process heat (A/IPH), and (4) synthetic fuels and products (SFP). The electric utility application data are presented for five classes of systems: baseload, intermediate, semi-peaking, peaking and "fuel savers". Fuel savers are solar electric options without storage or backup. The SHACOB data are presented for five system types covering a wide range in demand load. These systems include domestic hot water only (liquid); heating and hot water (air and liquid); heating, cooling by absorption air-conditioning, and hot water (liquid); and heating, cooling and hot water with heat pump auxiliary (liquid). The A/IPH data are presented for eight applications using water, air and steam at delivery temperatures ranging from 40 to 800°C. System performance is estimated for nine locations representative of the census regions in climate, with proximity to industrial centers of concentration. The SFP data are delineated by product type. The only product applications considered are low and medium Btu gas, synthetic (high Btu) natural gas (SNG), synthetic crude oil (syncrude), methanol and ammonia. Costs for SFP systems are developed for biomass feedstocks, high sulfur coal, oil shale, and an equatorially-located ocean thermal energy conversion (OTEC) system.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 56719, 56761, 56772

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

56700 (DOE/NASA/1022—78/31) **Inverter/controller subsystem optimized for photovoltaic applications.** Pickrell, R.L.; O'Sullivan, G.; Merrill, W.C. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Abacus Controls, Inc., Somerville, NJ (USA)). 1978. Contract EX-76-A-29-1022. 10p. (CONF-780619—10). Dep. NTIS, PC A02/MF A01.

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Conversion of solar array dc power to ac power stimulated the specification, design, and simulation testing of an inverter/controller subsystem tailored to the photovoltaic power source characteristics. The optimization of the inverter/controller design as part of an overall Photovoltaic Power System (PPS) designed for maximum energy extraction from the solar array is discussed. The special design requirements for the inverter/controller include: (1) a power system controller (PSC) to control continuously the solar array operating point at the maximum power level based on variable solar insolation and cell temperatures; and (2) an inverter designed for high efficiency at rated load and low losses at light loadings to conserve energy. It must be capable of operating connected to the utility line at a level set by an external controller (PSC). This paper is presented in three sections: (1) the overall PPS and PSC design (Utility Mode); (2) the inverter design and test results; and (3) a PPS analysis and simulation testing, conducted at LeRC to verify the design control concepts and fix design parameters.

56701 **Grain-boundary edge passivation of GaAs films by selective anodization.** Pande, K.P.; Hsu, Y.; Borrego, J.M.; Ghandhi, S.K. (Electrical and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, New York 12181). *Appl. Phys. Lett.;* **33**: No. 8, 717-719(15 Oct 1978).

Solar cells built on polycrystalline gallium arsenide usually have very leaky reverse characteristics and, consequently, low open-circuit voltage. These problems arise from the effect of the Schottky diode made on the grain boundary, which behaves like n^+-material. This diode shunts the active Schottky solar cell and deteriorates its performance characteristics. In this letter we describe the use of selective-anodization techniques to provide an insulating barrier over the edge of the grain boundary in order to passivate it. Leakage current reduction of 5—6 decades has been achieved by this method, with both aqueous and nonaqueous anodization methods.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 57095

56702 (DOE/EDP—0005) **Environmental Development Plan (EDP). Fuels from biomass, 1977.** (Department of Energy, Washington, DC (USA)). Mar 1978. 54p. Dep. NTIS, PC A04/MF A01.

The present status, program goals, and potential applications of biomass technology are briefly described. The potential environ-

mental and socioeconomic impacts of biomass production and conversion are identified. Six key environmental issues are cited and their nature and planned research associated with them are discussed. The six issues specified are the following: (1) The large land and water requirements of terrestrial biomass plantations may restrict the development of competing uses of land and water for food and fiber production in some regions and cause adverse socioeconomic impacts. (2) Biomass plantations have the potential to affect significantly air and water quality through fugitive dust emissions and sediment loads to waterways. (3) Removal of agricultural and silvicultural residues and total harvesting or clear cutting schemes reduce the amount of organic matter returning to the soil. (4) Direct combustion of biomass can in some cases emit greater quantities of nitrogen dioxide, carbon monoxide and particulates than fossil-fuel combustion. (5) The various thermochemical biomass conversion processes produce small quantities of pollutants such as hydrogen sulfide and phenols which can affect air and water quality. (6) Anaerobic digestion produces a sludge which must be disposed of or recycled carefully to avoid pollution of groundwater or surface waterways. An appendix tabulated completed, current, and planned research in these areas. (JSR)

56703 (MTR—7485(Vol.9)) **Systems descriptions and engineering costs for solar-related technologies. Volume IX. Biomass fuels production and conversion systems.** Blake, D.; Salo, D. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 197p. Dep. NTIS, PC A09/MF A01.

This document presents descriptions of conceptual production and conversion systems for biomass fuels. The data presented are developed from system performance analysis and estimated engineering and operation and maintenance costs of these conceptual designs to provide a data base for predicting penetration for future solar and solar-associated technologies. Biomass production and conversion systems utilize various technologies and process routes to transform feedstock into energy-related products. There are several sources of feedstock but basically only three distinctly different approaches exist for feedstock conversion to specific products. The biomass production systems which are considered here include: silvicultural biomass farms, agricultural biomass farms, forestry residues, and crop residues. Forestry residues include: logging residues, unutilized standing biomass, and unused mill residues. The basic conversion approaches used in the various processes are: thermochemical, aqueous processing and combustion. Representative products considered in the conversion section are: methanol, ethanol, medium-Btu fuel gas, ammonia, fuel oil, electricity, and charcoal. METREK estimated biomass production costs for ten different locations. Annual production was set at 250,000 DTE for each. Six of the sites were representative of areas where biomass farms would probably be established. They included: Wisconsin, Missouri, Louisiana, Georgia, New Hampshire/Vermont, and Washington. Illinois represented prime nonirrigated cropland, California represented irrigated cropland; the Mississippi site was established on U.S. Forest System land; and the Florida site was located in a wetland area. Detailed analyses are provided for Wisconsin and Louisiana. (MCW)

56704 (PB—278482) **Biophotolysis of water to hydrogen and oxygen. Semi- and annual progress report, 1 July 1974—30 June 1975.** Krampitz, L.O. (Case Western Reserve Univ., Cleveland, OH (USA)). 12 Jun 1975. 63p. NTIS PC A04/MF A01.

This research attempts: (1) to demonstrate that the thermodynamically feasible biophotolysis of water to hydrogen and oxygen by the action of the oxygen-evolving photosynthetic system and hydrogenase activity can occur with favorable kinetics; and (2) to search for a stable reduced photosynthetic product which can serve as a precursor of electrons for the reduction of protons to hydrogen catalyzed by hydrogenase in a dark reaction. Hydrogen formation is conducted from photosynthetically formed TPNH by a bacterial hydrogenase. Reduced triphosphopyridine nucleotide (TPNH) was formed by spinach grana in an illuminated condenser. Hydrogen formation was conducted by the blue-green alga, Anacystis nidulans. Hydrogen formation was conducted employing an oxygen-evolving and a bacterial photosynthetic system. The search for a stable photosynthetic reduced product includes formate research and viologen research.

56705 (SAN—7405-77/1) **Species control in large-scale algal biomass production. Final report.** Benemann, J.R.; Koopman, B.L.; Murry, M.; Weissman, J.C.; Eisenberg, D.M.; Oswald, W.J. (California Univ., Berkeley (USA). Sanitary Engineering Research Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1977. Contract W-7405-ENG-48. 215p. (UCB/SERL—77-5). Dep. NTIS, PC A10/MF A01.

This project deals with the development of biomass production technology for planktonic microalgae. A review of this subject details the use of such algae in waste treatment and the problem of harvesting the many types of microscopic algae occurring in ponds. The solution of this problem is deemed to be development of algal species control techniques which allow cultivation of desirable algal types harvestable through the most economic methods available. In the outdoor experiments, circular 3-m^2 ponds were used and were fed daily settled sewage, were mixed with paddle wheels, and were maintained at a variable detention time and fixed depth (10 inches). The ponds were inoculated with the filamentous blue-green alga, Oscillatoria and harvested with microstrainers. The Oscillatoria culture could not be maintained for long against an invading Scenedesmus sp. The naturally appearing alga Micractinium was much more successful in maintaining itself in the experimental ponds. However, even this species could not survive adverse conditions despite extensive recycling. The outdoor experimental ponds were effective in removing chemical oxygen demand (COD) and ammonia-nitrogen (NH_3-N) from influent sewage, achieving removals of 50 percent and 80 percent, respectively. Laboratory experiments concentrated on demonstrating the selective recycle theory. A mixture of Spirulina (a filamentous blue-green alga) and a small unicellular green alga could be maintained with either organism predominating, depending on recycling. An economic analysis of algal biomass production indicates the feasibility of algal biomass production and conversion to methane and fertilizer as by-products of sewage or liquid waste treatment assuming the availability of species control technology.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 56680, 57287

PHOTOVOLTAIC POWER PLANTS

56706 (MTR—7485(Vol.8)) **Systems descriptions and engineering costs for solar-related technologies. Volume VIII. Photovoltaic central power systems.** Cherdak, A. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 108p. Dep. NTIS, PC A06/MF A01.

Based upon the results of ERDA-sponsored study programs, capital and operating and maintenance cost estimates have been derived for a variety of photovoltaic central power systems. The ERDA studies developed conceptual designs for systems without storage capability. These results were modified to reflect consistent technological and costing bases. Using these results, a series of generic photovoltaic system designs were developed with and without energy storage. Estimated costs for these systems show that the structure required to support the photovoltaic collectors is expected to be a major portion of system costs.

56707 **Satellite solar power stations.** Vanke, V.A.; Lopukhin, V.M.; Savvin, V.L. (M. V. Lomonosov State University, Moscow). *Sov. Phys. - Usp. (Engl. Transl.);* **20**: No. 12, 989-1001(Dec 1977).

A review is given of the present state of work on the development of satellite solar power stations (SSPS) that will be placed in geosynchronous orbits and will convert solar into electric energy and then transfer it in the form of a microwave beam to the earth's surface. The idea of the SSPS was first put forward in 1968 and has since been the subject of considerable development work by a number of companies and government agencies in the USA. SSPS may be regarded as a promising variant of a power system that is capable, at least in principle, of solving the basic problem in power engineering since it is capable of drawing upon an inexhaustible source of energy (the sun). It is also capable of eliminating the problem of ecological contamination, of high efficiency of the energy transfer system (up to 80%), and of flexibility in the redistribution of the available energy among remote consumers. The review analyzes the individual aspects of the problem of developing the SSPS.

SOLAR THERMAL POWER PLANTS

56708 (AD-A—051101) **Preliminary design of a 10 kWe solar heated open Brayton-cycle engine. Phase I. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1977. Contract N68305-76-C-0014. 76p. (ADL-C—79516-F). NTIS PC A05/MF A01.

This report discusses the results of the first phase of a two-phase program to assess the applicability of electric power generation from solar energy at Naval bases, particularly advanced bases which require small, mobile systems not under development in the civilian sector. For purposes of establishing a baseline system against which the costs and benefits of various solar-to-electric energy conversion processes can be compared, an open-cycle air turbine/generator set was chosen with tracking parabolic dish reflector to focus direct solar radiation onto a collector/heat exchanger providing heat for the engine.

56709 (MTR—7485(Vol.5)) **Systems descriptions and engineering costs for solar-related technologies. Volume V. Solar thermal electric systems.** Curto, P. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 190p. Dep. NTIS, PC A09/MF A01.

A study of the technologic and economic characteristics of solar-related technologies has been performed for ERDA's Division of Solar Energy. This volume describes in detail several design concepts for solar thermal electric power plants. Estimates of resource impacts--manpower, materials, energy, and costs--have been made for each primary design concept. This study can serve as a foundation of information and data for future impacts studies, engineering evaluations, and market studies. The major contractors which are working with ERDA on these systems have produced volumes of information which have been analyzed to supply the raw data used in this report. The major central receiver concepts are discussed in detail. A generic central receiver system incorporating some of the best design features has been costed and presented. Distributed collector systems are discussed and evaluated as to relative costs and performance.

CENTRAL RECEIVER

56710 **Solar-MHD energy conversion system.** Rathbun, K.R. US Patent 4,095,118. 13 Jun 1978. Filed date 26 Nov 1976. 24p.

A solar energy conversion system includes a centrally positioned tower supporting a solar receiver, and an array of pivotally mounted reflectors disposed circumferentially therearound which reflect earth incident solar radiation onto the receiver which thermally excites and photo-ionizes a working fluid to form a plasma. The plasma is accelerated and further heated through a ceramic turbo-compressor into a magnetohydrodynamic (MHD) generator to produce direct current. The working fluid is then passed through a heat exchanger channel where the waste heat is removed by another working fluid which drives a vapor turbine connected to the ceramic turbo-compressor and an AC generator. Seed may then be removed and the working fluid is recycled in the closed cycle MHD system. The electrical power is distributed, part of it being used to electrolyze water into hydrogen and oxygen which are stored and allowed to exothermally recombine to drive the system during low solar radiation intervals. In a further embodiment the MHD working fluid receives its velocity from an external turbo-compressor drivem by the second working fluid, and an alternative thermal and photo-ionization chamber is employed. 16 claims, 10 figures.

DISTRIBUTED COLLECTOR

REFER ALSO TO CITATION(S) 56711, 56784

TOTAL ENERGY AND HYBRID SYSTEMS

56711 (SAND—78-7004) **Sandia Solar Total Energy Test Facility Project. Final report, Suntec 260 Square Meter SLATS Subsystem.** Zender, S.N. (Suntec Systems, Inc., Lakeville, MN (USA)). [nd]. Contract EY-76-C-04-0789. 59p. Dep. NTIS, PC A04/MF A01.

First, the 37 m^2 SLATS (Solar Linear Array Thermal System) Test Module is described including its control and instrumentation and test results. Next, the 260 m^2 SLATS System is described including its performance predictions, installation, and economic analysis. (MHR)

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 56969

56712 (AD-A—049552) **OTEC anchors: selection and plan for development. Final report May 1975—March 1977.** Valent, P.J.; Atturio, J.M. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Dec 1977. 30p. (CEL-TR—859). NTIS PC A03/MF A01.

Anchor systems capable of maintaining the Ocean Thermal Energy Conversion (OTEC) power plants on station were identified and compared. Deadweight anchors with base shear keys were selected as the best choice for the more common ocean environments. Concepts for transporting and lowering the required deadweight anchor systems to the seafloor site are described and their limitations noted. The attractiveness - and technical feasibility - of using a free-fall-emplaced deadweight anchor installation is highlighted. Pile anchors attached to a common frame (template) were selected as the better choice on the hard (rock) seafloors often found in the high-energy, shallow-water areas of the Gulf Stream. Further development of the pile anchor system for OTEC, however, is probably not necessary because it is expected that such hard seafloor anchor sites are best avoided by OTEC plants. A plan for development of the free-fall-emplaced deadweight anchor is presented and a plan for implementation recommended. The development plan includes evaluation of the hydrodynamic stability of the free-falling anchor, development of the soil-penetration/anchor-deceleration inter-relationship, assembly of a structural analysis and design technique for the anchor, and finally a demonstration of a near prototype size OTEC free-fall deadweight anchor in early 1980.

56713 (CONF-780550—5) **Ocean thermal energy conversion (OTEC) power plant instrumentation and measurement.** Lewis, L.G. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From Seminar on testing solar energy materials and systems; Washington, DC, USA (22 May 1978).

The objectives of the Ocean Thermal Energy Conversion (OTEC) program were analyzed in order to determine the types of measurements that will be needed on the power cycle and the accuracies that will be required. The results indicate that precise measurements will be required to provide meaningful results on parts of the program. It is probable that conventional instrumentation of the type used in chemical manufacturing or petroleum refining will be inadequate. Some of the instrumentation used at the OTEC heat exchanger test facility at Argonne may be suitable for use in an OTEC plant, while other instrumentation may not be suitable even though the accuracies are high. This is the result of the large size of the equipment in an OTEC plant compred to the sizes of the laboratory exchangers.

56714 (MTR—7485(Vol.7)) **Systems descriptions and engineering costs for solar-related technologies. Volume VII. Ocean Thermal Energy Conversion (OTEC).** Eldridge, R.; Roberts, R. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 133p. Dep. NTIS, PC A07/MF A01.

The ocean thermal energy conversion (OTEC) study projects the capital cost of this technology through the end of the century. This projection is based on a generic design resulting from the analysis and collation of features of designs proposed by the TRW Systems Group, Inc., and Lockheed Missile and Space Company, Inc. (LSMC). The generic design is based on a spar-buoy hull, a titanium heat exchanger and a fiber-reinforced plastic cold water pipe. Reduction of the base plant cost derived ($2930 per kWe) is achievable through alternate heat exchanger material selection, improved technology, and manufacturing experience. These are estimated to reduce production plant costs to $1463 per kWe. A recently revised LMSC design, based on a higher temperature differential and aluminum heat exchangers, results in a published power cost of $1294 per kWe in 1975 dollars for a temperature differential of 37.8°F. When adjusted for a higher cost of concrete and escalated to 1976 dollars, the cost estimate becomes $1548 per kWe. This revised design was used as the base for estimating power and delivered energy costs for Southeastern United States, Puerto Rico and Hawaii.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 56736

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 56757, 57108

56715 **Solar-bivalent heating and water heating for a 50-bed hotel.** *IKZ Fachz. Sanit.-Heiz.-Klima;* **32**: No. 15, 57-59(1977). (In German).

In the 50-bed hotel in Hodenhagen (Lower Saxony), a solar-bivalent system has been installed for heating and water heating. The rooms are heated with a floor heating system. Solar energy is utilized with the aid of heat pumps. For the operating costs of this heating system, a 35% saving is expected compared to the costs of an oil-fired heating system. The functioning of the plant is illustrated by a layout plan.

56716 (FSEC—77-8, pp 397-404) **Solar heating and cooling residential demonstration program: U.S. Department of Housing and Urban Development.** Dubin, F.S. (Dubin-Bloome Associates, New York). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The chronology, development, and experience of the HUD program are reviewed briefly. (MHR)

56717 (FSEC—77-8, pp 99-110) **Performance of a low-cost plastic film solar water heater.** Mears, D.R. (Rutgers—The State Univ., New Brunswick, NJ); Roberts, W.J.; Baird, C.D. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A low-cost plastic film solar water heater has been developed and evaluated. It is being applied in the heating of greenhouses and the results to date are extremely encouraging. The greenhouse heating system is technically feasible and appears to be economically feasible as well at today's energy costs. The prototype solar collectors built to date have been constructed on wooden frames 13-ft across to utilize 14-ft wide rolls of polyethylene tubing. The units can be any length required. The frame is then covered with 5 layers of polyethylene film, the two outer layers being clear and the center film black. Air is blown between two inflated pillows. Water introduced through a perforated pipe at the top of the collector runs down over the top of the black sheet and is collected in a return gutter at the bottom. Several techniques have been developed to enhance sheet water flow at relatively low water flow rates. Complete wetting of the black surface has been found necessary for maximum operating efficiency. The design and construction of the collector are discussed and the influence of several design modifications on the thermal performance of the unit are presented. The integration of the collector into a complete greenhouse solar heating system is shown.

56718 (FSEC—77-8, pp 187-195) **High efficiency, direct expansion solar panel.** Franklin, J.L. (Sigma Research, Inc., Richland, WA); Saaski, E.W.; Yamagiwa, A. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A hybrid solar panel/heat pump system was developed. The addition of the heat pump to the system, though requiring additional material and maintenance costs, does permit the collection system to operate at a lower temperatuue and, consequently, a higher efficiency. In this hybrid system a reduction in the installed system cost was of primary concern. This was accomplished by designing a new collector panel for the heat pump, the essential feature of which is the total lack of both glass cover sheets and insulation. These two components have been eliminated by circulating the boiling refrigerant directly through the collector and operating the panels slightly below ambient air temperature. In this way, thermal loss prevention techniques are seen to be unnecessary and are, in fact, detrimental, since energy can now be obtained from the ambient air and environment by convection and radiation.

56719 (FSEC—77-8, pp 405-417) **Experiences from ERDA's commercial demonstration program.** Parker, A.J. Jr. (Mueller Associates, Inc., Baltimore). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

ERDA's current commercial demonstration program comprises five (5) cycles, each one of which is advertised through a Program Opportunity Notice (PON). The first PON cycle was initiated with the release of PON DSE 75-2 and the subsequent receipt by ERDA of some 300 responses in November, 1975. In late Spring, 1976, 32 awards were negotiated to successful respondees. In November, 1976, ERDA received about 300 responses to the second PON cycle advertisement. Somewhere between 40 and 60 awards are expected to be made during the Spring of 1977 to successful respondees. This process is expected to be continued for three more PON cycles yielding some 200 commercial demonstration projects nationally. In addition to the PON process, as part of the Phase I Solar Heating and Cooling of Non-Residential Buildings Demonstration Program, about a dozen projects are being initiated. Also, through unsolicited proposals, several additional solar demonstration projects were and continue to be funded. Thus, ERDA's solar commercial demonstration program will include approximately 250 projects nationally. Observed experiences from the owners, owners' design team, supplier/installer/and ERDA's viewpoint are discussed. Leverage that ERDA's program appears to have on the commercial sector is indicated.

56720 (FSEC—77-8, pp 419-446) **Experiences from the Santa Clara Community Center solar energy project.** Anderson, L.B. (Acurex Corp., Mountain View, CA). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The City of Santa Clara, California, has an extensive solar energy program to investigate the potential for widespread application of solar energy by a public entity, in this case the city-operated public utility. Under an Energy Research and Development Administration contract, titled "Solar Heating and Cooling as a Public Utility," the City has added a solar-powered air conditioning, heating, and domestic hot water system to its new community center building to evaluate the system's thermal performance and the practical aspects of this form of solar energy utilization. Conceived late in 1973, the solar hardware project has evolved through a series of learning experiences and is virtually complete in April, 1977. Cost of the installed solar hardware system was $509,884, one-third of which represented labor cost. An additional $146,441 was paid for architect and engineer services. The breakdown into major cost categories is given. Practical problems encountered along the way included delays in release of funds, delays in obtaining certain valves, a strike, and assorted technical problems and malfunctions during hardware installation. With the exception of one valve and some insulation, all hardware is in place and is operational. Both of the 25-ton absorption-cycle water chiller units have been powered simultaneously by solar energy. This successfully demonstrates the major technical objective of this proof-of-concept experiment.

56721 (FSEC—77-8, pp 447-476) **Summary report on the Northview Junior High School solar energy demonstration project.** Merrill, G.L. (Honeywell, Inc., Minneapolis). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The design, installation, operation and evaluation of a solar energy system installed at Northview Junior High School, Brooklyn Center, Minnesota are covered. The system was operational in May of 1974 and was evaluated under contract from ERDA for one year. Qualitative evaluations are still being conducted. The system was designed around a 5,000 square foot flat-plate collector array and is used to supply solar-heated fluid to heat exchangers located within the building. The evaluation of the system included the following: determining the amount of effective solar energy collected, determining the utilization of the different solar system operating modes, evaluating cold weather heating performance, evaluating the system for solar heating potential, and determining the nature and level of solar flux values available for the year. The system was designed to provide energy for: (1) space heating (fresh and/or return air), (2) swimming pool water heating, and (3) domestic water heating. Over the one-year test period the system provided 629,000,000 Btu of collected energy with an average collector efficiency of 44%. The energy distribution was 54% for space heating, 25% for pool water heating and 21% for domestic water heating.

56722 (FSEC—77-8, pp 477-484) **University of Florida Solar Research Residence solar heating and cooling applications.** Farber, E.A.; Ingley, H.A.; Morrison, C.A.; Shipp, G.W. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Over twenty years ago a project was implemented to study the many aspects of maintaining a comfortable environment in a typical southern dwelling. The focal point of this research was a residence constructed for this study by the University of Florida Mechanical Engineering Department. Since its beginnings, the house was utilized for intensive research in the areas of infiltration, ventilation, comfort cooling and space heating. Families of various sizes have inhabited the house over the years, maintaining energy consumption data and performing a variety of experiments. This data base broadened over the years until another series of projects were begun to convert the major energy-using functions of the house to solar powered devices. A brief description of the solar systems that have been used at the Solar Research Residence is provided. Pertinent specifications for each system and a summary of their performance are also presented.

56723 (FSEC—77-8, pp 513-516) **Solar systems design manufacturer vs. engineer.** Barker, N.M. (PPG Industries, Inc., Pittsburgh). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

With the technical constraints of solar energy systems being overcome, two basic problems still exist. One, test data is inadequate, inaccurate and too often misleading. Certain criteria must be known for proper evaluation. Even when known, comparisons are difficult without simultaneous testing. Some suggestions are given as to how to overcome the problem. Two, the tremendous variations in collector configurations create a nightmare for the specifying engineer. It is also impossible to specify and detail a system so that more than one manufacturer can bid the project without substantial changes in piping and supports and therefore costs. Some suggestions for alleviating the problem are given.

56724 (FSEC—77-8, pp 565-571) **Probabilistic approach to sizing solar energy systems.** Swanson, S.R.; Austin, J.A. (Univ. of Utah, Salt Lake City). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The calculation of solar heating and cooling system performance has in the past emphasized average performance, as this is representative of long-term system performance. However, the extreme values of performance are also of interest in certain applica-

tions. The development of a statistical technique to give the distribution of system performance results is reported. In this method, weather records are divided into a number of discrete states of ambient temperature and insolation. A statistical transition matrix is then formed, and used with Monte Carlo simulation and a calculation of the system for each day's weather state. Computer run time appears to be low and the method appears useful for parameter studies where the distribution of system results is important.

56725 (FSEC—77-8, pp 605-618) **Economic analysis of solar water and space heating.** Bennington, G.; Bohannon, M.; Spewak, P.; Bezdek, R.; Maycock, P.; Roseman, E. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Based on comparison with conventional energy costs, solar water heating and solar space heating installed at an equivalent system cost of $20 per square foot of collector is competitive today against electric resistance systems throughout most of the U.S. If the system cost is reduced to $15 per square foot, solar systems become competitive against oil hot water heating and/or oil and electric heat pump space heating in many cities. Finally, if the cost should be reduced to $10/ft^2 by 1980 through a combination of technical innovations and incentives, solar hot water and heat would be economically competitive against all residential fuel types. Solar system designs for 13 cities were optimized so as to minimize the life-cycle cost over the assumed 20-year life time of the solar energy systems. The major assumptions regarding the solar system, type and use of building, financial considerations, and economic environment used in the design optimization are given.

56726 (FSEC—77-8, pp 635-643) **Some thoughts on the economics of solar heat.** Conta, L.D. (Univ. of Rhode Island, Kingston). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

It is generally accepted by most investigators that solar heating cannot compete economically with conventional heating systems. A more detailed look at the problem—more detailed in the sense of including additional relevant factors which are generally neglected—can lead to the conclusion that rapidly adopting solar heating is the only rational decision that can be made. Some of these factors are presented.

56727 (LA-UR—77-1048) **Energy savings for a solar heated and cooled building through adaptive optimal control.** Farris, D.R.; Melsa, J.L. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 23p. (CONF-780623—1). Dep. NTIS, PC A02/MF A01.

From International federation of automatic control, VII world congress; Helsinki, Finland (12 Jun 1978).

A study of the applicability of adaptive and optimal control techniques to the control of the heating, ventilating, and air-conditioning (HVAC) system of a solar heated and cooled building is described. The need for application of optimal and adaptive concepts is discussed and the selected approach is explained. A cost functional to define optimal performance and an identification process to produce a linearized building model are combined to yield an adaptive linear regulator solution. The building model is described and a conventional controller is simulated for comparison. Implementation of the adaptive optimal controller is described and simulation results are presented. Substantial savings in auxiliary energy requirements are obtained.

56728 (LA-UR—78-1263) **Solar collector related research and development in the United States for heating and cooling of buildings.** Collier, R.K. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 39p. (CONF-780667—2). Dep. NTIS, PC A03/MF A01.

From Symposium on solar energy; Cairo, Egypt (16 Jun 1978).

Some of the research funded by the Research and Development Branch of the Heating and Cooling Division of Solar Energy of the United States Energy Research and Development Administration is described. Specifically, collector and collector materials research is reported on during FY-1977. The R and D Branch has funded research in open and closed cycle liquid heating flat plate collectors, air heating flat plate collectors, heat pipe collectors, concentrating collectors, collector heat transfer studies, honeycomb glazings, evacuated tube collectors, ponds both salt gradient and viscosity stabilized, materials exposure testing, collector testing standards, absorber surface coatings, and corrosion studies. A short description of the nature of the research is provided as well as a presentation of the significant results.

56729 (MTR—7485(Vol.2)) **Systems descriptions and engineering costs for solar-related technologies. Volume II. Solar Heating and Cooling of Buildings (SHACOB).** Hewett, R.; Spewak, P. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 191p. Dep. NTIS, PC A09/MF A01.

Of the various solar energy technologies, the direct use of solar radiation for providing space heat and domestic hot water for homes and other buildings is closest to commercialization. Estimates are given of the costs of outfitting new and existing buildings with five generic types of solar energy systems--hot water; heating and hot water (using a liquid heat transfer medium); heating and hot water (using air as the heat transfer medium); heating, cooling and hot water; and the solar-assisted heat pump with heat pump cooling and hot water. Since there are as many solar energy system designs as there are manufacturers--literally hundreds--the generic approach is used to systematically investigate and catalog the costs associated with solar energy HVAC systems. Except for cooling applications, only liquid and air flat plate solar energy collectors are considered. For cooling applications cost estimates are generated based on evacuated tube collectors. For each generic system type, the costs given are the costs of designing, procuring and installing solar HVAC systems in new as well as existing buildings--including the conventional backup system costs. Systems capital costs are determined in terms of variable costs and fixed costs. Variable costs are directly dependent upon collector area and are given in terms of dollars per square foot. Fixed costs, being a function of hot water and/or building loads, follow a step function. Cost data for Thomason water trickle solar energy systems and for a sample of solar-equipped residences appear in the appendices.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 56745

56730 (FSEC—77-8, pp 119-125) **Experimental apparatus for direct solar drying.** Beach, C.D. (Florida Solar Energy Center, Cape Canaveral). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

An experimental solar dryer was designed to be used in finding the best way to use solar radiation in combination with heated air for drying a variety of food pieces. The dryer is designed to provide solar radiation on the top and bottom of the product and to allow for an adjustment in the amount of applied radiation from zero to about 2½ times the radiation incident on a flat-plate collector. Air flow can be controlled in volume and temperature through two separate drying beds. The mirrors and drying bed are mounted in a single structural framework and operated in fixed positions relative to one another. The unit will accept the sun from all angles during the middle four to six hours of the day without adjustment. Seasonal variations in the sun's incidence angles are accommodated by manual re-orientation of the entire unit with reference to its base.

56731 (FSEC—77-8, pp 127-131) **Flat-plate collectors applied to air drying of grain.** Shove, G.C. (Univ. of Illinois, Urbana). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Flat-plate solar collectors utilizing air as the energy transfer medium incorporated into the walls and roofs of machinery storage buildings, livestock shelters, and the sidewalls of grain drying bins are being investigated for their potential to supply the heat energy for drying grain. Flat-plate solar collectors readily adapt to the large flat areas available on farm buildings, and vertical south-facing walls and sloping roofs provide reasonably favorable orientation for collectors, particularly during the corn harvest months of September, October, and November. Roofs and walls of farm buildings can become solar energy collectors with only minor modifications in the building construction. For example, metal roofs or walls can become bare flat-plate collectors if provision is made to move air along the inside of the surfaces exposed to the sun's rays. Walls and roofs can be constructed as covered plate collectors by using clear fiberglass as the outer wall and roof covering over black energy absorbing surfaces. Grain drying requires large volumes of air; therefore, reasonably high air velocities can be maintained even in the attic space of large machine sheds and livestock shelters. Higher air velocities can be obtained if air is moved through a narrow chamber created by placing the energy-absorbing plate near the fiberglass cover. Design parameters as related to optimum dimensions are under study although choice of complete attic space versus a narrow chamber under the collector cover for air movement may depend in part on the construction details of the building. Data obtained on flat-pate collectors applied to grain drying have provided enough encouragement for some grain and livestock producers to install solar collectors for drying grain and heating livestock shelters even though cost-benefit ratios have not been established.

56732 (MTR—7485(Vol.3)(Rev.1)) **Systems descriptions and engineering costs for solar-related technologies. Volume III. Agricultural and Industrial Process Heat (A/IPH).** Curto, P. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1978. Contract EX-76-C-01-2322. 109p. Dep. NTIS, PC A06/MF A01.

Systems descriptions and engineering costs for solar-related technologies have been evaluated and estimated for ERDA's Division of Solar Energy. Engineering costs for solar agricultural and industrial process heat (A/IPH) systems are estimated in this volume. System descriptions are provided which physically describe the generic system modules, including collectors, heat transport, pumps, fans, controls, heat exchangers, and storage subsystems. Eight complete solar applications are fully described and costs are estimated, each using different collector concepts and different storage concepts, for a range of application temperatures from 40 to 200°C with water, air, and steam transport media. User applications are identified which can potentially be solar markets in the near future. The costs of alternative fuel utilization are provided as a background reference. Distributions of energy consumption by temperature, transport medium, and regional location are estimated for the purpose of providing raw data for a market penetration analysis.

WATER HEATING

REFER ALSO TO CITATION(S) 56715, 56720, 56721, 56722, 56725, 56729

56733 (FSEC—77-8, pp 645-652) **Economics of solar domestic water heating with flat-plate collectors.** Chandra, S. (Florida Solar Energy Center, Cape Canaveral). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The economics of solar domestic water heating primarily depend on the solar system installed cost, the expected present and future monthly savings in utility bills and the form of financing the system. Secondary variables affecting the economic outcome are system maintenance costs and applicable taxes. The homeowner is given a simplified method for determining solar system Net Lifetime Savings and Payback Periods for different forms of financing. Since the initial system cost varies widely it is treated as a parameter. The monthly savings in utility bills depends on the percent of energy supplied from solar, the hot water demand and the cost of auxiliary energy. The monthly saving is also treated as a parameter, but an estimate of it is given as a function of demand and type of auxiliary fuel used. Graphs are presented showing solar system Lifetime Savings and Payback Period as a function of system cost with monthly fuel savings as a parameter for different forms of financing. Effects of financing incentives are also examined.

OTHER

56734 (SAND—78-0189) **Commercialization of solar irrigation systems workshop.** McVeety, R.T.; Alvis, R.L. (Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-76-C-04-0789. 45p. Dep. NTIS, PC A03/MF A01.

Results are presented of the Commercialization of Solar Energy Systems Workshop cosponsored by the U.S. Department of Energy and Sandia Laboratories on the topics of market potential, location, and magnitude of the irrigation market. A scenario for production and marketing of solar irrigation systems was proposed. Three working groups studied and reported on the following questions: What can the farmer pay. What is the system cost. What are alternate system uses. Summaries of these group studies are presented. The groups concluded that more experiments are necessary before production of systems can begin. Accordingly, a progress update meeting will be held in 6 months.

56735 **Thermal panel powered heat engine.** Yates, J.W. US Patent 4,051,678. 4 Oct 1977. Filed date 12 Mar 1975. 10p.

A heat engine is described operating from power derived from the difference in temperatures between, for example, solar heat ambient air and an underground water source. A plurality of enclosed tanks are supported in radially opposed pairs from a framework which is rotatable about a horizontal axis. Each tank has its interior divided by a flexible membrane to provide first and second chambers. The first chamber of each tank contains a liquid propellant, and the two first chambers of each radially opposed pair of tanks are interconnected for fluid communication therebetween. The second chamber of each tank contains a high vapor pressure fluid and is coupled to an evaporator coil positioned adjacent its tank and to a condensor coil positioned adjacent the radially opposite tank. The lower-most tank has its first chamber first coil within a hot reservoir to cause the high vapor pressure fluid to expand, applying pressure to the flexible diaphragm of that tank. A thermal panel is made up of a mallic plate member and a pipe in thermal contact therewith. An underground water source supplies one of the hot and cold reservoirs, while water passing through the thermal panel pipe supplies the other. The thermal panel supplies the hot reservoir when its temperature is greater than the temperature of the underground water or the cold reservoir when the ambient air temperature is less than the temperature of the underground water. A thermal storage tank stores heat from the heat elements powering the generator for heating the water of the hot reservoir when the ambient air temperature is close to the underground water temperature.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 56717, 56718, 56730, 56731, 56733

56736 (FSEC—77-8) **Proceedings of 1977 flat-plate solar collector conference.** Ward, D.B. (ed.). (Florida Solar Energy Center, Cape Canaveral (USA)). Sep 1977. 672p. (CONF-770253—). Dep. NTIS, PC A99/MF A01.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

Sixty papers are included. A separate abstract was prepared for each paper for Energy Research Abstracts. Two papers were included in EAPA. (MHR)

56737 (FSEC—77-8, pp 3-11) **Solar collector technology update.** Sargent, S.L. (Enery Research and Development Administration, Washington, DC). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Highlights are presented summarizing an opening presentation to a second national workshop devoted exclusively to the technology of solar collectors. The discussion is to assess the changes in that technology since the first workshop, in light of the ERDA Solar Heating and Cooling Research and Development program.

56738 (FSEC—77-8, pp 13-21) **Solar collectors: past, present, and future.** Yellott, J.I. (Arizona State Univ., Tempe). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The history of solar collectors going back to 212°B.C. is traced briefly. The flat plate collector seems to have come into existence in 1885 in France. Early use of solar water heaters is described. Selective surfaces; convective losses; swimming pool heaters; collector testing, certifying, and standards; problems; and various concentrating collectors are reviewed briefly. (MHR)

56739 (FSEC—77-8, pp 23-44) **Summary reports from state-of-solar technology discussion workshops.** Williams, R.; Lof, G.O.G.; Cole-Appel, B.E.; Lowery, G.W.; Streed, E.R.; Anderson, L.B. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The state of flat-plate solar collector technology as of March, 1977, is summarized in six reports prepared in discussion workshops by conference participants and presented verbally at the conclusion of the conference. The edited workshop reports are presented. Topics of the discussion workshops were as follows: Flat-Plate Solar Collectors--Liquid and Phase-Change Types, Flat-Plate Solar Collectors--Air Type and Agricultural Applications, Flat-Plate Solar Collectors--Advanced Types, Tests and Standards for Solar Energy Systems, Collector Materials and Coatings, and Manufacturing and Economic Considerations for Solar Collectors. These workshop discussions and reports summarize advancements in solar technology which have occurred since the 1974 collector workshop and thereby provide a next benchmark for research and development of flat-plate solar collectors.

56740 (FSEC—77-8, pp 47-62) **Design, fabrication, and testing of a low-cost flat-plate collector.** Holland, T.H. (Honeywell, Inc., Minneapolis). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The development of a low-cost flat-plate solar energy collector for the heating and cooling of residential buildings is described. The objective of the collector design effort was to produce a solar collector capable of meeting specified performance requirements, at the desired system operating levels, for a useful life of 15 to 20 years, and to do it at the minimum cost, given state-of-the-art materials and technology. The primary consideration was to minimize costs rather than to provide performance in excess of the minimum system requirements.

56741 (FSEC—77-8, pp 63-66) **Low-cost, non-metallic, mat-type developments in collectors.** MacCracken, C.D. (Calmac Manufacturing Corp., Englewood, NJ). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

From the technology of ice skating rinks, a low-cost, non-metallic, mat-type liquid solar collector has been developed and is being manufactured which will withstand high temperatures, provide high efficiency, is very light in weight, can roll out 4 feet wide by 125 feet long, has a projected life of thirty years or more, reduces plumbing costs many fold, and because it is freeze-tolerant uses city water directly without any heat exchanger.

56742 (FSEC—77-8, pp 67-73) **Thermal performance of an open fluid-film solar collector.** Beard, J.T.; Iachetta, F.A.; Messer, R.F.; Huckstep, F.L.; May, W.B. Jr. (Univ. of Virginia, Charlottesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

An outdoor solar test facility has been designed and constructed for determining steady-state thermal performance of an open fluid-film solar collector. Full size collectors are tested under various ambient and fluid flow conditions. The open fluid-film solar collector is similar in principal to an open water-trickle solar collector. However, the fluid flows as a near-uniform film over a flat collector plate, and typically the fluid is a silicone oil which appears to have negligible evaporation. Thermal performance results are presented in standard graphical and tabular forms for high and low wind conditions.

56743 (FSEC—77-8, pp 75-81) **Performance of a stationary concentrating collector for heating, cooling, and process heat applications.** Schertz, W.W. (Argonne National Lab., IL); Peters, T.; Levitz, N.; Allen, J.; Rabl, A.; Cole, R. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The design and performance of a prototype collector suitable for operation in the intermediate temperature range (100-170°C) is described. The collector is a nonimaging concentrator with an evacuated glass tube receiver for reducing the heat loss. A concentration ratio of 1.5, based on the circumference of the absorber tube, allows efficient operation at temperatures in the intermediate temperature range 100-170°C while allowing the collector to remain totally stationary throughout the year. The collector has been operated at 165°C above ambient with a 45% efficiency (based on total insolation). The collector is approximately 22 cm deep, does not require adjustments or tracking, and may be directly substituted for a flat-plate collector. The higher temperatures that may be obtained with this collector should allow improved performance of solar powered cooling systems as well as improved collection efficiency during the heating season in cold climates. Calculations of the amount of energy that can be delivered during a year as a function of output temperature are also presented.

56744 (FSEC—77-8, pp 83-96) **Performance analysis of the Solarvak flat-plate solar collector.** Estes, J.M. (Solarsystems, Inc., Tyler, TX); Faulkner, R.F.; McClure, J.D. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The development of a math model that closely follows the test results can be a valuable tool in analyzing various combinations of variables that exist in a flat-plate vacuum collector. The Solarvak collector, with its unique characteristics, can achieve high temperatures (250 F at 50 percent efficiency) that can open new doors to other uses, as well as economically perform the standard tasks of water and space heating. This type of collector, with its heavily insulated plate, will perform the same task as standard flat-plate collectors with less area and will perform better under severe conditions of low ambient or low solar levels.

56745 (FSEC—77-8, pp 133-140) **Modified plastic flat-plate collector for grain drying.** Chau, K.V.; Baird, C.D. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A 12-ft x 96-ft collector was constructed with plastic materials on a wooden frame. The collector was covered with one layer of 6-mil clear polyethylene, and the floor was made of a layer of 6-mil black polyethylene laid over urethane insulation boards, 1.25 inches thick. Between the black plastic and the clear plastic, there was a layer of black polypropylene screen with 45 percent opening. The air flowed over and under on both sides of the plastic screen. It was found that this collector is significantly more efficient than a similar collector without the suspended plastic screen. Also the temperature of the black plastic is reduced when the plastic screen is in place. Efficiency is definitely affected by air flow rates, varying from 19% at 1 cfm/ft^2 of collector area to 34% at 2.7 cfm/ft^2. Solar radiation rates have only a very slight effect on efficiency.

56746 (FSEC—77-8, pp 143-154) **Flat-plate air-heater improvements.** Cole-Appel, B.E.; Lof, G.O.G.; Shaw, L.E. (Solaron Corp., Denver). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Cost-effective improvements to flat-plate air-heaters are studied. The overall objective is to increase the rate of heat transfer from the absorber to the flowing air thereby increasing the amount of collected energy. This improvement must be made without increasing the collector cost disproportionately. The heat transfer rate equation between the absorber and air flow demonstrates that either the heat transfer effectiveness or the temperature difference between absorber and air must be increased. The absorbers chosen for fabrication must meet the following general criteria: (a) The pressure drop through the collectors should not be increased substantially over that associated with the current design. (b) The proposed absorber designs must be adaptable to the internal manifold concept that is presently used in the Solaron collector. (c) The designs must be cost-effective improvements, i.e., the percent increase in useful energy collected must be greater than the percent increase in collector cost. (d) The air flow must not be in direct contact with the glazing. In the testing and comparison phase of this project the absorbers will be mounted in a collector pan of the present design using glass covers and a non-selective black absorber coating. With these criteria in mind an estimate of the following parameters was made: (1) Heat transfer effectiveness, (2) pressure drop, (3) increase in collector performance based on the Hottel-Whillier-Bliss model, and (4) collector cost.

56747 (FSEC—77-8, pp 155-159) **Jet impingement solar air heater.** Rask, D.R. (Honeywell, Inc., Minneapolis). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The results to date on the development of a low-cost solar air heater are described. A unique jet-impingement concept is used as the absorber plate-to-air stream heat-transfer mechanism. The program objective is to design, fabricate, test and evaluate the jet-impingement concept collector. For comparison purposes, a baseline parallel-plate collector was analyzed, fabricated and tested. A computer simulation using a nodal network collector model is used to predict collector performance. The collector mechanical design effort involved a study of cost effective methods for assembly and material selection. A preliminary recommended design is presented. In summary, it has been recommended that aluminized steel sheet, pre-painted with an acrylic paint, be used for the box material. A semi-rigid fiber glass, 2.54-cm (1-inch) thick, with an aluminum facing is recommended for the insulation. A steel absorber plate and a pre-assembled nozzle plate or perforated plate is used for the jet plate. Two sheets of 0.318-cm (0.125-inch) tempered, low-iron glass are recommended for the glazings. The baseline parallel plate test results and the best jet plate collector results to date are presented.

56748 (FSEC—77-8, pp 161-168) **Grooved foamglas flat-plate solar collector.** Loth, J.L. (West Virginia Univ., Morgantown). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The construction and performance of a low-cost air cooled flat-plate collector is described. The collector consists of a cover plate and one and one half inch of Foamglas backing. The collector side of the foam backing is machined into 30-degree angle V grooves, which are painted black and have a high effective absorptivity, for either diffuse or internal specular reflection. The black surface area, which has to transfer the collected heat to the air has almost three times the area of the collector cover. Also the exposed foam airpockets increase the convective heat transfer coefficient. These factors result in a five-fold reduction of the usual temperature difference between the absorber surface and the air. The test results indicate the air cooled collector efficiency to be comparable to that of the reference water-cooled collector.

56749 (FSEC—77-8, pp 171-177) **Binary-phase collector.** Molivadas, S. (Business and Tech., Inc., Washington, DC). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A new cycle is discussed for transferring heat from a solar collector to a heat reservoir. A key feature of the cycle is that the working fluid absorbs heat in the collector by evaporation and

releases it to the storage medium in the reservoir by condensation. Thus, in contrast to single-phase liquid or gas cycles, whose working fluids always remain in the same phase, the fluid in the new cycle alternates between the liquid and vapor phase in its principal path around the system. The new cycle is operating successfully in a new building in Washington, D.C.

56750 (FSEC—77-8, pp 179-185) **Preliminary assessment of a heat pipe flat-plate collector.** Evans, R.D.; Greeley, D.N. (Florida Technological Univ., Orlando). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

An assessment has been made of the merits of utilizing heat pipes as the heat transfer elements in a flat-plate solar collector for providing space heating to a building. Several alternatives were investigated relative to the techniques of integrating heat pipes into a flat-plate collector configuration. A theoretical model for a heat pipe flat-plate collector has been developed and can be used to predict the thermal performance of such a solar energy collection device. The results of the study indicate that heat pipes can be successfully used as the heat transfer elements in a flat-plate collector. However, the thermal resistance between the condenser section of the heat pipe absorber and the collection fluid manifold must be minimized in order for the thermal performance of the heat pipe collector to approach that of a conventional flat-plate collector. An experimental heat pipe collector has been designed and is now undergoing performance testing to determine its actual thermal performance under a variety of solar and environmental conditions.

56751 (FSEC—77-8, pp 199-205) **Collector technology for heating and cooling: a technical and economic forecast.** Woulbroun, J.M.; Wengert, P.R. (Owens-Illinois, Inc., Toledo). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Collector technology for heating and cooling applications falls under three categories: flat plates, concentrating and focusing devices, and evacuated tubular collectors. It appears that the evacuated tubular technology can provide high temperature performance making air conditioning with solar energy a reality. This high temperature performance both at low and high ambient, in any wind condition, along with low insolation levels makes this technology unique. Improved performance requires lower heat losses. These losses can only be eliminated by interposing a vacuum between the cover and the absorber. This introduces very difficult problems for the large flat glass collectors. In contrast the round cross section of a tube can easily withstand the strains introduced by evacuation. Glass is also required for strength and transparency reasons. In addition, glass is the ideal material for solar collectors for the following reasons: it has unique properties, is easily formed, is economically mass produced, the low-cost raw materials are readily available and energy conversion cost to manufacture them is low on a comparable weight basis. The all-glass collector has a long life expectancy with low maintenance costs. And finally, the simple design is projected to have the lowest manufacturing cost in high volume production.

56752 (FSEC—77-8, pp 207-220) **Optimal geometries for one- and two-faceted symmetric side-wall booster mirrors.** Mannan, K.D. (Punjab Agricultural Univ., Ludhiana, India); Bannerot, R.B. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Moderate concentration in east-west aligned non-tracking, trough-like solar energy collectors is examined. Two designs are evaluated in detail. They are the one- and two-facet plane side-wall configurations. The maximum performance designs are shown not to be the most practical designs since they tend to require disproportionately large reflectors. A significant reduction in reflector area can be made with only a small degradation of performance. At solstice a nine-degree collector acceptance angle is necessary for 8 hours of collection. Under this restriction the practical concentration ratios are limited to about 2 and 2.6 for the one- and two-facet designs, respectively.

56753 (FSEC—77-8, pp 221-225) **Inverted flat-plate collector.** Brown, M.A. (Applied Solar Tech., Inc., Columbia, MD). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A unique inverted flat-plate solar collector is described with an energy-gathering efficiency inversely proportional to the angle of solar elevation. An analysis using real weather data has shown that this design can out-perform a double-glazed, "upright" collector in providing space heating and domestic hot water.

56754 (FSEC—77-8, pp 227-238) **Experimental performance of plastic honeycomb in flat-plate solar collectors.** Marshall, K.N.; Dammann, R.E. (Lockheed Palo Alto Research Lab., CA). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A test program was carried out to evaluate the performance of solar collectors containing hexagonal-shaped honeycomb made from thin-film plastics of Lexan, Mylar, Tedlar, and Kapton. Testing was conducted simultaneously on both honeycomb and nonhoneycomb collectors to obtain a direct comparison of performance. Both flat black and selective black collectors were evaluated over the temperature range of 313°K (104°F) to 395°K (250°F). Results confirmed that properly designed plastic honeycomb collectors provide a significant improvement in performance over that of nonhoneycomb collectors. Instantaneous efficiencies above 50 percent (50%) were obtained for operating temperatures up to 383°K (230°F). Comparison of diurnal operation between honeycomb and nonhoneycomb collectors shows even larger increases in performance by the honeycomb collectors for those plastics which are highly transparent to solar energy.

56755 (FSEC—77-8, pp 239-245) **New flat-plate solar collector using total internal reflection for light trapping.** Phillips, R.L.; Evans, R.D. (Florida Technological Univ., Orlando). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The phenomenon of optical total internal reflection (TIR) is due to an abrupt decrease of the index of refraction of a material. This physical principle is used to trap and contain light in optical fibers. Using the TIR principle a small 2 ft x 3 ft prototype solar collector panel was designed. The collector was constructed from $^1/_{16}$-inch colorless plexiglas (ultra-violet transmitting) plastic consisting of triangular corrugated channels mounted on a plexiglas surface. The corrugated triangular rows were constructed so as to provide a conduit for the fluid and to provide the desired light trapping effect. Headers were fabricated from the same material and integrated into the collector panel. Three prototype collectors were fabricated: One with an ordinary plexiglas back surface, a second one with a diffuse-reflecting back surface and a third with a blackened diffuse-reflecting back surface. A diffuse surface insured that what light was reflected from the back would be dispersed throughout the fluid. The collector was placed in an insulated box for thermal performance evaluation.

56756 (FSEC—77-8, pp 247-251) **Moderately focusing flat-plate solar collector.** Robertson, H.S. (Univ. of Miami, Coral Gables, FL). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A design is discussed and analyzed for a non-tracking solar collector that collects from the whole sky, yet concentrates the beam and circumsolar radiation enough to cause significant improvement in the performance of the collector over that of a comparable flat plate. The typical range of concentrations for beam radiation is shown to be $1.3 < C < 1.6$. As an example of the performance improvement that is to be expected, for the required output temperatue of 110°C, with input temperature at 20°C and ambient at 30°C, and insolation at 500 W/m², a high quality flat-plate collector might exhibit an efficiency of 45%, whereas the typical efficiency of a comparable collector of this design is 55%, a 23% improvement.

56757 (FSEC—77-8, pp 253-263) **Flat-plate collector performance in a solar-assisted heat pump system.** Hewitt, E. (Solar Associates, Hartford); Raman, K. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

In the work discussed here, the characteristics of a flat-plate collector determine the overall performance of a solar-assisted heat pump system with long-term storage and year-round operation, in a Northern climate is examined. The economics of the system are discussed for different performance characteristics of the flat-plate collector. It is shown that for a range of values of the load, it is possible to design a cost-effective, high-performance system with a relatively small collector area. The sizing of the collector, as determined by the two-stage, year-round operation of the system, is discussed in detail. It is pointed out that the use of high-performance flat-plate collectors (which implies a larger collector cost) can result in a lower total cost for the overall system for a wide range of system parameters.

56758 (FSEC—77-8, pp 267-279) **Results of a roundrobin flat-plate collector test program.** Streed, E.R. (National Bureau of Standards, Washington, DC). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A roundrobin solar energy collector test program has been conducted to evaluate a proposed test method to rate collectors on the basis of thermal performance. Two liquid-type collectors were distributed to 21 organizations in the United States to obtain data in various climatic regions using the prescribed apparatus under allowable ranges of environmental conditions. Plots of the efficiency as a function of the difference in average fluid temperature and ambient temperature divided by the insulation were used to obtain performance curves for each collector. The overall transmittance-absorptance produce (F'α tau) and the overall heat loss coefficient (F'U/sub L/) were determined by each participant using a least-squares analysis of the data. The mean and standard deviation for each of these parameters is calculated and the significance with respect to the testing and rating of collectors is discussed.

56759 (FSEC—77-8, pp 281-293) **Use of ASHRAE Standard 93-77 in predicting all-day performance of flat-plate collectors.** Zerlaut, G.A.; Dokos, W.T.; Heiskell, R.F. (Desert Sunshine Exposure Tests, Inc., Phoenix, AZ). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Tests were conducted at Desert Sunshine Exposure Tests, Inc., utilizing the ASHRAE Standard 93-77 test method with the incident angle modifier experimentally determined for three collectors. All-day efficiency tests were also performed on collectors at tilt angles and operating conditions typical of end use. Using the governing plot of "instantaneous efficiency" determined in accordance with ASHRAE 93-77, the incident angle modifier, and the ASHRAE insolation and incident angle tables, the all-day collector heat gain (output) was computed solely on the basis of the instantaneous efficiency tests. Concomitantly, actual all-day efficiency tests were obtained by integration of experimental all-day data. Excellent agreement was observed between the all-day data points and the analyzed data from instantaneous efficiency determination, regardless of whether experimentally determined governing equations were used to derive all-day data, or whether experimentally determined all-day data were used to derive the governing equation.

56760 (FSEC—77-8, pp 295-301) **Stagnation testing of flat-plat solar collectors: use of the governing equation in diagnostics.** Zerlaut, G.A.; Dokos, W.T.; Heiskell, R.F. (Desert Sunshine Exposure Tests, Inc., Phoenix, AZ). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Stagnation testing involves, quite simply, the exterior (real-time exposure) of solar collectors in the non-operative dry condition, after first filling with transfer fluid, which is permitted to evaporate in the early stages of stagnation. Depending on the length of exposure testing, the Hottel-Whillier governing plot of the collector is determined initially and then quarterly or semi-annually for the duration of the exposure test. Stagnation- and operational-induced changes in any or a combination of these parameters are manifest in the governing plot and the physical basis for collector malfunction can be diagnosed with little difficulty. The possible exposure-induced changes, many of which are subsystem interactive or synergistic, are described by changes in the governing equations of the collector.

56761 (FSEC—77-8, pp 303-312) **Florida Solar Energy Center's tests and standards program.** Huggins, J.C.; Lowery, G.W.; Roland, J.D. (Florida Solar Energy Center, Cape Canaveral, FL). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The Florida Legislature recently enacted the Solar Energy Standards Act of 1976, now Section 377.705, of the Florida Statutes. This law, effective October 1, 1976, directed the Florida Solar Energy Center (FSEC) to develop standards for solar energy equipment sold or manufactured in the State, establish criteria for determining the performance of solar energy equipment and maintain a testing facility for evaluating the performance of solar energy systems and components. The act provided for the Center to charge a fee to cover costs of testing and allowed for the acceptance of test results from other testing organizations. As a result of the legislation, the Florida Solar Energy Center has implemented the first stage of a Test and Standards program through a solar collector testing and certification procedure. The test facility, test procedures, and typical test results are described.

56762 (FSEC—77-8, pp 313-326) **Performance evaluation of flat-plate solar collectors: testing methods and results.** Godrick, J.A.; Sliney, J.L. (Kennecott Copper Corp., Lexington, MA). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Methods for obtaining instantaneous efficiency and long term performance data for liquid flat-plate solar collectors are discussed from the standpoint of collector design, with special emphasis on experimental techniques which can be used to produce reliable results. The use and limitations of instantaneous efficiency tests for evaluating solar collector design options is illustrated with specific examples. An experimental system designed to simulate hot water heating applications is described, and performance data obtained from continuous operation through 1976 in Lexington, Massachusetts, are given. Considerations which enter into the use of such data for guiding collector design are discussed.

56763 (FSEC—77-8, pp 329-344) **Extended test program for solar collector optical materials.** Gilligan, J.E.; Brzuskiewicz, J.; Brzuskiewicz, J.E. (IIT Research Inst., Chicago). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The optical and physical properties of many of the materials used in solar energy collectors critically affect the overall performance of those systems. Most important are the initial properties and the effect on them of environmental exposure. The initial optical properties, for example, essentially fix the upper limits of system efficiency. A large number of actual and potential solar utilization materials are currently being exposed to outdoor weathering at three different sites and in a variety of configurations and test modes. Measurements of the spectral transmittance of solar cover materials and of the spectral reflectance (absorptance) of solar absorber surfaces provide the basic information regarding materials suitability. Tensile properties, impact strength, abrasion resistance, and similar mechanical properties and their weather-durability characteristics form, in effect, a secondary set of characteristics—secondary in the sense that only if the optical properties and their durability are satisfactory does one then look at mechanical properties and their durability. The materials currently under test are categorized as follows: transparencies (glass, rigid plastics, and thin-film plastics); absorbers (flat and selective blacks); and reflectors (first and second surface mirrors).

56764 (FSEC—77-8, pp 345-348) **Development of an absorber coating based on the electromagnetic wave energy conversion theory (EWEC).** Farber, E.A.; Ingley, H.A.; Shipp, G.W. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The development of EWEC is discussed briefly and the possibilities it has for solar thermal applications are pointed out. Following the recommendations of the theory's origination, staff members of the University of Florida Solar Energy Laboratory set up a research project to determine what, if any, effect the EWEC concept had on the operational characteristics of a flat-plate collector. A summarization of the testing procedure is given to better acquaint the reader with an ongoing selective coating testing program. Data developed from the various tests are presented and analyzed. The significance of these data and their relationship to EWEC is discussed. Along with the experimental data obtained at the University of Florida, the authors will also review several other projects which are similar to the EWEC concepts and apparently validate EWEC even though those involved in the research offer other explanations as to the performance of their collectors.

56765 (FSEC—77-8, pp 349-366) **Design and modification of glass properties by means of surface coatings.** Hsieh, C.K.; Rajvanshi, A.K.; Su, K.C. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Equations are given for predicting directional spectral reflectivity, transmissivity and absorptivity for glass plates with either clear or thin film coated surfaces. The glass bulk properties are used to formulate equations for predicting glass properties for a double-layered glass system. A computer flow diagram is also given to facilitate the user to develop computer programs suitable for his own system. To facilitate applications, tables of weighted ordinates values are collected for conversion from spectral to total properties. The glass refractive index and extinction coefficient values are also tabulated for use as inputs to the computer program. Finally, an example is given to illustrate how the equations are used to design an antireflection glass.

56766 (FSEC—77-8, pp 367-376) **Teflon FEP fluorocarbon film for flat-plate solar collectors.** Ribbans, R.C. III. (E.I. du Pont de Nemours and Co., Inc., Wilmington, DE). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The manufacture of "Teflon" began over 35 years ago. It is in a unique class of polymers that have no hydrogen. Fluorine replaces this element entirely. The chemistry suggests applications in solar energy where severe environmental conditions and long-term endurance requirements are very demanding. Economic considerations point favorably toward the use of "Teflon" FEP film in flat-plate solar collectors. A review of "Teflon" FEP properties shows that is should serve well as the inner glazing. The solar transmittance is 96% for a 1-mil film, the index of refraction is 1.34 and the upper long-term service temperature is 400°F. Real-time Florida weathering tests conducted over the past 15 years show almost no change in properties. A solar collector array was erected at Chestnut Run and it is providing confirming evidence for the assumptions made from property data sheets. Results to date indicate that inner glazing of 1-mil "Teflon" FEP film increased daily heat collection over glass inner glazing with non-selective heat absorbers. The difference was ca. 8% on sunny days but increased to over 30% for hazy and cloudy days. The data also show value for "Teflon" FEP film under plastic outer glazing and over selective surface heat absorbers. Practical experiences and advice for installing films of "Teflon" FEP are presented.

56767 (FSEC—77-8, pp 377-382) **New generation of material for solar collector covers.** Keller, S.F. (Kalwall Corp., Manchester, NH). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

As a result of continued efforts to find new and better materials for the emerging solar energy industry, Kalwall Corporation has developed a new fiberglass-reinforced product for use as an experimental collector cover material. Although all the test cited in this paper are relatively short term, the results are encouraging enough and the need great enough that we feel the solar energy industry should consider the use of this new material. This new material has a trade name of Sun-Lite Premium II. Favorable results are reported for the following properties: solar energy transmission, moist heat resistance, ultraviolet degradation, thermal degradation, combustibility characteristics, impact resistance, and thermal shock.

56768 (FSEC—77-8, pp 383-386) **Performance of Sun-Lite I (Premium) vs ordinary glass as glazing materials for flat-plate solar collectors.** Smith, W.F. (Florida Technological Univ., Orlando). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

An evaluation has been made of the performance of Kalwall Company's Sun-Lite-I (Premium), 0.040-in. thick sheet, as a glazing material for single-glazed flat-plate solar collectors. Two identical flat-plate solar hot-water heating systems were set up side-by-side on the roof of the Engineering Building at Florida Technological University. In one system Sun-Lite-I (Premium) was used as the solar collector material while ordinary $^3/_{16}$-in., 0.13% Fe_2O_3 glass was used for the other. On the basis of the hot water produced over 6-hr test periods, the Sun-Lite-I glazing material was found to be 80 to 85% as efficient as the ordinary glass cover. Different conditions of cloud cover were investigated, but no correlation between efficiency and cloud cover was obtained.

56769 (FSEC—77-8, pp 387-394) **Commercially available materials suitable for use in flat-plate solar energy collectors.** Ratzel, A.C. (Sandia Labs., Albuquerque, NM); Bannerot, R.B. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The information contained in this compilation was supplied by the manufacturers, and the authors make no claim for its validity. The data was assembled in the Fall of 1975 and prices are as of November, 1975. The following tables are included: Table 1 Cover Materials: Mehanical Properties; Table 2 Cover Materials: Thermal and Radiative Properties; Table 3 Cover Materials: Availability and Cost; Table 4 Absorber Coatings - Electroplated: Technical Data; Table 5 Absorber Coatings - Dip or Chemical Conversion: Technical Data; Table 6 Absorber Coatings - Paints: Technical Data; Table 7 Absorber Coatings - Electroplated: Application and Cost; Table 8 Absorber Coatings - Dip or Chemical Conversion: Application and Cost Data; Table 9 Absorber Coatings - Paints: Application and Cost Data; Table 10 Insulations: Mineral Wool; Table 11 Insulations: Industrial Felt; and Table 12 Insulations: Foamglas and Fiberglas.

56770 (FSEC—77-8, pp 485-500) **Baseline performance of solar collectors for NASA Langley Solar Building Test Facility.** Knoll, R.H.; Johnson, S.M. (National Aeronautics and Space Administration, Cleveland). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The Solar Building Test Facility located at the Langley Research Center in Hampton, Virginia, currently utilizes a 1180-square-meter (12,700-ft^2) solar collector-field to help heat and cool a 4650-square-meter (50,000-ft^2) office building. The solar collector field contains seven collector designs. Before operation in the field, the experimental performances (thermal efficiencies) of the seven collector designs were measured in an indoor solar simulator at the Lewis Research Center in order to provide a baseline for later comparison with actual field test data. The simulator test results are presented for the collectors as received and after several weeks of outdoor exposure with no coolant (dry operation). Six out of the seven collector designs tested showed substantial reductions in thermal efficiency after dry operation.

56771 (FSEC—77-8, pp 503-512) **Importance of design parameters for successful manufacture of flat-plat collectors.** Farber, E.A.; Ingley, H.A.; Morrison, C.A. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

A number of different flat-plate solar collector designs are discussed based on innovations taking advantage of the basic characteristics of glazing materials, absorber plate configurations, absorber plate materials, and nonselective or selective coatings, and the type of insulation used in the collector. The temperature and compatibility restrictions imposed by some materials and the collector box design and construction are also discussed. Specific problems, which must be faced in proper collector design and construction, such as structural strength, moisture control, and modular integration in building structures will also be presented. Guidelines are developed to help the manufacturer determine which design or construction variables are important or not, emphasizing changes which will effect the performance greatly and others which will not. These guidelines will also provide a guide for the consumer to judge the quality of a flat-plate collector and to predict its performance potential.

56772 (FSEC—77-8, pp 517-524) **Solar collectors net energy and environmental impact potential.** Hedden, R.E.; Parker, A.J. Jr. (Mueller Associates, Inc., Baltimore). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Rather than employ an assessment/evaluation methodology developed around a framework of critical assumptions and subjective value scales, a more quantitative approach is proposed centering around real projects. Emphasis has been placed on areas which are amenable to quantification: materials usage, energy supplied, and pollution avoided. Such an approach is essential if the relative benefits and costs of solar energy systems and subsystems—specifically flat-plate collectors—is to be established with certainty. An evaluation framework is proposed which will employ data generated from real projects to allow comparison of a variety of alternative collector subsystems. Unit factors for emission potential and energy requirements can be combined with real design, real cost and real performance data to arrive at the "energy efficacy" of various solar subsystems, and combined with pollution avoidance data, for assessment of the overall environmental impact of specific solar systems and subsystems.

56773 (FSEC—77-8, pp 525-534) **Variety of cost-effective flat-plate absorbers based upon continuous selective black chrome-plated metal foils and strip.** Cotsworth, J.L.; Beatty, C.C. (Berry Solar Products, Edison, NJ). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

To achieve reasonable efficiencies with medium or high temperature solar collectors, it is a recognized necessity that the absorber surfaces must be selective. Overwhelming evidence from numerous research programs indicates selective black chrome electroplated on a proper metal surface is the most effective and durable of all coatings now available. With the proper copper foil and strip surface, absorptivity readings of 0.93 up to 0.96 and emissivity readings of 0.10 down to 0.06 are obtained. The commercial application of this coating by the batch process is costly, and only recently was it possible to employ a continuous strip electroplating machine which assures both substantial cost reduction and better quality control. The first interest was in bonding the thinnest foil to a metal absorber plate, headers, or tubes with high-temperature adhesives. With aluminum extrusions fitted for copper tube, for example, the foil product, known as SolarFoil, can readily be applied to the surface of the extrusions. A heavier product called SolarStrip was developed to serve directly as a selectively black-chromed absorber plate. Since

flat-plate absorber tube spacing is typically 4-in., an 0.009-in. thickness was selected because it is considerably less expensive than 0.016-in. in use for flat-plate absorbers with 6-in. spacing. Forming such precoated strip with grooves to accept copper tubing was not found to be a problem, although extra care is taken not to abraid the coating. Attachment of the tube by soldering and epoxy bonding also succeeded. Because of the thin metal, some undesirable warpage occurs which is more detrimental to appearance than function. A more cost-effective method of tube attachment is being investigated.

56774 (FSEC—77-8, pp 535-542) **Panel fabrication, array design, and durability tests of the Pleiad collector.** Spencer, D.L. (Univ. of Iowa, Iowa City); Laughlin, D.E. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

The University of Iowa vacuum flow flat-plate collector is described in terms of manufacturing considerations. Pleiad Industries, Inc., of West Branch, Iowa, has been licensed by the University of Iowa Research Foundation to build and market these collectors. The Pleiad collector is composed of a pair of thin (0.006 in. or 0.15 mm) sheets, each 2 ft x 10 ft (0.61 m x 3.05 m) in nominal dimensions, one of which is deep-textured to a mean depth of approximately 0.015 in. (0.38 mm). The two sheets are seamed together around the periphery, forming an envelope. Liquid subheaders are formed in the plain sheet before welding. Inlet and drain tubes are silver-soldered to these sub-headers, and flow is provided so that the pressure is always slightly below that of the atmosphere at these inlet and exit points. This is sufficient to assure that negative pressures exist throughout the flow region between the sheets, and the sheets are thus held together by the pressure differential between atmospheric and fluid pressures. A uniform passage is maintained by the texture pattern. This approach virtually eliminates several parameters that apply to most other designs, and results in an expected average energy gain of some 15% over sheet-and-tube designs, and over thick-walled, positive-pressure sandwich designs. Material is included on panel fabrication, array design, and durability tests.

56775 (FSEC—77-8, pp 545-552) **Analysis of reflector-augmented flat-plate collector performance.** Espy, P.N. (Marshal Space Flight Center, Huntsville, AL). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Flat-plate collectors are often installed on flat roofs and other horizontal surfaces. For such installations the use of fixed planar reflectors in conjunction with flat-plate collectors increases the energy collected per unit area of collector surface. Also, the collection at higher temperatures is possible. Most importantly the cost effectiveness of the collector system is increased as the summer collection increases to better match the air conditioning demands of a southern climate. A comparison is made between the unit collector area performance of a proposed collector-reflector array and a rather standard heat/air-condition solar collector system. The collector type is assumed in each case to be a selective absorber unit having a single cover plate. Solar flux on a daily basis is computer-derived from hourly ASHRAE values of diffuse and beam components to determine total day performance. Performance improvements for the proposed system varies from about 40% in mid-winter to 160% in mid-summer for the example used. Additional cost to a solar heating and cooling system is expected to be between 10% and 30%.

56776 (FSEC—77-8, pp 553-563) **Forced convection in simple solar collectors.** Shehata, A.M.; McEligot, D.M. (Univ. of Arizona, Tucson). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Numerical solutions are presented for the temperature distribution and heat losses for a hypothetical two-dimensional solar collector formed of a single absorbing plate and glass cover in direct contact with the fluid. The forced convective aspects of the problem are emphasized. Since the stability of such duct flows depends on heating rate, fluid and flow direction, the study compares predictions for water and air flows with both turbulent and laminar flow. At the flow rates chosen, there is no significant difference for water flows, but for air turbulent mixing causes a substantial difference in the rate of growth of the thermal boundary layer and consequent heat loss from the glazing.

56777 (FSEC—77-8, pp 573-579) **Effect of ground reflectance on solar system simulation.** Wantoch, R.H. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Flat-plate solar collector models and system design procedures use values of solar insolation calculated from measured insolation on horizontal surfaces. At any angle other than horizontal, the collector "sees" the ground. Most solar system performance calculation procedures assume ground reflectance is 0.2 for the entire year. The ground reflectance is about 0.7 during periods of snowcover. In the northern half of the United States, there is sufficient snowcover during the winter months to affect solar system performance. The weather data of three stations in the northern half of the United States is analyzed to determine the amount of snowcover. Ambient temperature and percent sunshine coincident with snowcover are determined to assess the applicability of the performance calculation procedure. Performance curves are presented for standard calculation and snowcover correction with various loads and collector tilts from 0 to 90 degrees.

56778 (FSEC—77-8, pp 581-586) **Performance computer modeling of flat-plate solar collectors.** Farber, E.A.; Ingley, H.A.; Morrison, C.A. (Univ. of Florida, Gainesville). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Insight is given into the methods and value of computer modeling of flat-plate collector performance, discussing the importance and proper use of the computer, what it can do and what it cannot do, and urges caution in using this method and gives guidelines for the proper interpretation of the results.

56779 (FSEC—77-8, pp 587-602) **Solar energy study for the Naval Regional Medical Center, Orlando, Florida.** Hadden, R.M.; Rainer, G. (Flack and Kurtz, Consulting Engineers, New York). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Since the utilization of solar energy is only one of many energy conservation measures, it was necessary to analyze all the energy requirements of the Medical Center as a whole. Energy requirements vary throughout the year based on weather conditions. In order to obtain a clear understanding of these annual patterns, a dynamic load analysis was performed. The building was divided into 11 thermal blocks, that is, areas having similar thermal characteristics and use patterns. Using the program developed by Ross Meriwether Associates in conjunction with weather tapes as compiled for Orlando, Florida, by the U.S. Weather Service, energy requirements for every hour of the year for each of the thermal blocks were obtained. Monthly and annual summaries for heating and cooling requirements for all thermal blocks were the result. Medical facilities have large service hot water requirements for laundries, clinics, food service and general cleanup. These requirements were also input into the computer program as separate thermal blocks. Results are shown. The Medical Center has certain requirements for steam in kitchen facilities and for sterilizers. These needs were derived. The basic fan and pump electric requirements were determined so that changes for the solar system's use could be evaluated. (MHR)

56780 (FSEC—77-8, pp 619-633) **Cost-effective selection of flat-plate solar collectors.** Deffenbaugh, D.M.; Carper, H.J. (Southwest Research Inst., San Antonio, TX). Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

An experimental program was conducted to determine the instantaneous thermal efficiencies of 16 different flat-plate solar collector designs. These collectors featured selective and nonselective absorber plate coatings, and single and double covers of water-white crystal glass, float glass, and fiberglass-reinforced plastic. An indicator based on initial collector cost and instantaneous thermal efficiency was devised to allow selection of the most cost-effective collector. It is shown that the cost effectiveness varies with operating conditions, and that a single collector design is not necessarily the most cost effective for all operating conditions. All-day efficiency tests were conducted for several collector designs, and the results were used to predict the long-term thermal performance for all 16 collector designs. Two design examples are presented in which the initial cost of the collector bank for each of the 16 collector designs is calculated. It is shown that the savings realized by selecting the most cost-effective collector in comparison with the least cost-effective collector can be as high as 60 percent.

56781 (FSEC—77-8, pp 653-662) **Economic studies of plastic honeycomb solar collectors.** Marshall, K.N. (Lockheed Research Lab., Palo Alto, CA); Wedel, R.K.; Hollands, K.G.T. Sep 1977.

From Flat-plate solar collector conference; Orlando, FL, USA (28 Feb 1977).

In Proceedings of 1977 flat-plate solar collector conference.

Performance and cost data are presented for various flat-plate solar collectors, including those with Lexan honeycomb. A comparison is made between the efficiencies and costs of the various designs.

A relative cost analysis shows the most effective collector for different temperature regions. The analyses show that collectors equipped with Lexan honeycomb are more cost effective than comparable nonhoneycomb collectors when operating at temperatures greater than 108°F above the ambient.

56782 (SAND—78-0432C) **Heliostat dust buildup and cleaning studies.** Berg, R.S. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 20p. (CONF-780350—1). Dep. NTIS, PC A02/MF A01.

From Solar thermal central power systems semi-annual review; San Diego, CA, USA (2 Mar 1978).

The range of techniques that can be used to reduce dirt accumulation are described and some of the corresponding experiments being performed at Sandia are discussed. The mechanisms of dirt impingement and adhesion and the time development of adhesion forces are studied. The behavior of adhesion forces leads to restrictions on the periods when dirt is most susceptible to removal and on the potential removed techniques that can be used. The following experimental investigations are discussed: reducing dust deposition, cleaning solution investigations, high pressure spray washing, and dirt characterization. (MHR)

56783 **Corrugated cover plate for flat plate collector.** Hollands, K.G.T.; Sibbitt, B. (to Dept. of Energy). US Patent 4,078,544. 14 Mar 1978. Filed date 26 Apr 1976. 4p.

PAT-APPL-680,605.

A flat plate radiant energy collector is provided having a transparent cover. The cover has a V-corrugated shape which reduces the amount of energy reflected by the cover away from the flat plate absorber of the collector.

56784 **Fixed-mirror solar concentrator for central station generation.** Russell, J.L. Jr. (General Atomic Co., San Diego, CA). *Proc. Am. Power Conf.;* **39**: 622-634(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design, production, cost analysis, performance testing, and systems analysis of fixed-mirror solar concentrators for use in a solar thermal power plant are described. Also, brief discussions of the solar energy market and solar hydrogen production are included. (WHK)

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

56785 (NP—23258) **Prospects for geothermal energy.** Paris, L. (Corporate Unverified). 1977. 17p. (In Italian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Precise evaluation of geothermal resources is difficult, and can be done only on a short-term basis. At present, only high temperature geothermal fields are being exploited for electricity production. Those fields now having operational power plants are of the vapor-dominated or water-dominated type. Low-temperature fields are being used to some extent for industrial process heat, space heating, and agriculture, usually in areas immediately adjacent to the heat source. The geothermal fields of Italy and the United States are described and evaluated. Geothermal energy should not be viewed as an alternative energy source, but rather as an integral part of the energy resource system. Several more years of study will be required for determination of the feasibility of hot-dry-rock systems. Five references are provided.

USA

56786 (TREE—1116, pp 321-325) **Use of relevance trees in geothermal planning.** Close, J.A.; Shepherd, J.C.; Stepan, I.E. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Relevance trees were developed to provide a graphic display of all elements of the geothermal program and to systematically evaluate the alternative courses of action by identifying the potential impact of each program on the national goals. Themes being developed by the relevance trees include organizational, resource characterization, programmatic, and regional structure. The themes and levels of inquiry used to develop the trees are illustrated. (JGB)

NON-USA

REFER ALSO TO CITATION(S) 56787

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

56787 (CONF-7610109—3) **Pannonian basin: a Mediterranean interarc basin.** Horvath, F.; Stegena, L. (Corporate Unverified). 1976. 8p. Dep. NTIS (US Sales Only), PC A02/MF A01.

From 25. congress and plenary assembly of CIESM; Split, Yugoslavia (22 Oct 1976).

The Pannonian Basin is of the interarc, intermountain-retroarc type. It should not be considered to be of Mesozoic or Cenozoic age, as Precambrian and/or Paleozoic strata are intercepted in deep drilling. Dissimilarities between Mesozoic and earlier formations suggest that the area resulted from the collision of two micro-plates during the Tertiary. The post-orogenic sedimentation during the Miocene-Pliocene, and Pliocene-Pleistocene volcanism are described. The results of seismic, magnetotelluric, and gravity investigations in the area are summarized. The Pannonian Basin as a whole represents a distinct geothermal high. The temperatures at a depth of 1.0 km are 70 to 80°C, and near surface heat flow is 2.0 to 2.6 HFU. Extrapolation of data indicates that mantle temperatures are also high beneath the Basin, and that the mantle may be partially melted. Temperature, heat flow, low velocity layer, and high conductivity layer data support this conclusion. The present aseismicity of the Basin and the Carpathians indicates that the subducted lithosphere has been assimilated and that basin evolution is essentially complete.

GEOCHEMICAL TECHNIQUES AND SURVEYS

56788 **Nuclear techniques in the evaluation of geothermal resources.** Wollenberg, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 379-391 of Nuclear techniques and mineral resources 1977. Vienna; IAEA (1977).

From IAEA international symposium on nuclear techniques in exploration, extraction and processing of mineral resources; Vienna, Austria (7 Mar 1977).

Nuclear techniques are employed in exploration, development and monitoring of production of geothermal resources. An understanding of the relationships between heat flow and heat production in a region depends on the knowledge of natural radio-element contents of crustal materials. These contents are most readily determined by field and laboratory gamma-spectrometric methods. Radio-element contents of hot spring systems and produced geothermal fluids are also determined by gamma spectrometry, as well as by alpha-spectrometric and neutron activation analyses. Contents of major and trace elements, some of which are used as the bases for chemical geothermometers, are analysed by X-ray fluorescence and neutron activation. Mass spectrometric techniques are employed to determine oxygen and hydrogen isotopic ratios, and abundances and ratios of noble gases in geothermal fluids. Anomalous contents of soil-gas mercury, a potential indicator of hydrothermal circulation, may be detected in the field by atomic absorption equipment. As in petroleum and mineral exploration, drilling for geothermal resources is guided and evaluated by subsurface logging, utilizing nuclear techniques.

EXPLORATORY DRILLING AND WELL LOGGING

56789 (SAND—78-0443C) **Drilling into molten rock at Kilauea Iki.** Colp, J.L.; Okamura, R.T. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 4p. (CONF-780708—11). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The scientific feasibility of extracting energy directly from buried circulating magma resources is being assessed. One of the tasks of the project is the study of geophysical measuring systems to locate and define buried molten rock bodies. To verify the results of a molten rock sensing experiment performed at Kilauea Iki lava lake, it is necessary to drill a series of holes through the solid upper crust and through the molten zone at that location. Thirteen holes have been drilled in Kilauea Iki. The results achieved during the drilling of the last two holes indicated that the molten zone in Kilauea Iki is not a simple, relatively homogeneous fluid body as expected. The encountering of an unexpected, unknown rigid obstruction 2.5 ft below the crust/melt interface has led to the conceptual development of a drilling system intended to have the capability to drill through a hot, rigid obstruction while the drill stem is immersed in molten rock. The concept will be field tested at Kilauea Iki in the summer of 1978.

56790 (SAND—78-0668C) **High temperature instrumentation for geothermal applications.** Veneruso, A.F.; Stoller, H.M. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 4p. (CONF-780708—7). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The technical development of geothermal borehole instrumentation is divided into three tasks: (1) severe environment components development, (2) prototype system development, and (3) borehole test and evaluation. The experimental prototypes will be tested in geothermal boreholes. (JGB)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

56791 (UCRL—80945(Rev.1)) **Processing of geothermal brine effluents for injection.** Quong, R.; Schoepflin, F.; Stout, N.D.; Tardiff, G.E.; McLain, F.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1978. Contract W-7405-ENG-48. 5p. (CONF-780708—12). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

Brine effluents from the San Diego Gas and Electric/Department of Energy—Geothermal Loop Experimental Facility were characterized for particulate concentration and chemical composition. Bench scale tests were conducted with inorganic and organic coagulants as a means of enhancing the sedimentation process for separation and removal of suspended solids, principally amorphous silica. The effects of temperature, retention time, and pH on the precipitation of supersaturated silica, subsequent floc settling properties, and supernatant clarity were determined. A pilot sized clarifier with mixed media sand or precoal pressure filtration were successfully tested as a means of producing injectable brine effluents. Preliminary cost estimates range in the vicinity of 20 cents/1000 gallons.

GEOTHERMAL POWER PLANTS

56792 (TREE—1116, pp 327-329) **Transient modeling and simulation of the geothermal electric plant.** Miller, J.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A transient model of the Raft River Geothermal Electric Plant was developed for parallel implementation on digital and hybrid computers. The simulation is to be used for systems analysis work supporting preliminary design and procurement activities. The mathematical model is illustrated schematically. The transient thermo-hydraulic behavior of the brine, working fluid (isobutane), and coolant (water) loops is represented with emphasis on the thermal response to atmospheric and controller variations and the anticipated class of malfunctions. (JGB)

POWER PLANT SYSTEMS AND COMPONENTS

56793 (LBL—7040) **Thermodynamic and cost benefits of a floating cooling geothermal binary cycle power plant at Heber, California.** Pines, H.S.; Pope, W.L.; Green, M.A.; Doyle, P.A.; Silvester, L.F.; Fulton, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 7p. (CONF-780708—19). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The application of the floating cooling concept to evaporative heat rejection systems was studied as a method of improving the performance of geothermal power plants operating upon medium temperature hydrothermal resources. The LBL thermodynamic process computer code GEOTHM was used in the case study of a 50 MWe isobutane binary cycle power plant at Heber, California. It was found that operating a fixed capacity plant in the floating cooling mode can generate significantly more electrical energy at a higher thermodynamic efficiency and reduced bus bar cost for approximately the same capital investment. Floating cooling was also found to minimize the adverse influence on plant performance due to a declining resource temperature.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 56790, 56798

56794 (LA-UR—78-907) **Geothermal drilling in hot granitic rock.** Williams, R.E. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 4p. (CONF-780708—5). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The status of resolution of the most urgent techniques and equipment problems in the drilling of hot dry rock is discussed. The following items are treated individually: mud motors; steering tools; open-hole packers; cementing; sidetracking in granitic rock; coring; and standard. The problem associated with each item and the present status of research are discussed. (JGB)

56795 (SAND—78-0598C) **Simulator for sensitivity analysis of geothermal well cost: progress report.** Polito, J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 2p. (CONF-780708—20). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

A computer-based simulator for geothermal well costs is being developed. The purpose of the project is to provide an analysis tool with which to investigate the sensitivity of geothermal drilling costs to various technological improvements. Output from the simulator will provide information to aid the research manager in the allocation of resources to research projects. In its final form the simulator will accept models of rotary and novel drilling systems at the level of aggregation specified by the user. An overview and progress report on the development of the simulator are presented.

56796 (SAND—78-0669C) **Continuous chain drill bit developments.** Newsom, M.M.; St. Clair, J.A.; Stoller, H.M.; Varnado, S.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780708—15). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

Portions of document are illegible.

Under DOE's Geothermal Well Technology Program, the Continuous Chain Drill Bit, in which fresh cutting surfaces are cycled into place without removing the bit from the hole, is under development by Sandia Laboratories. Fixed head bit testing has optimized cutting surface diamond patterns, developed adequate bit hydraulics, and solved the apex problem through application of Stratapex cutters in the bit nose. Prototype chain drill testing has demonstrated structural integrity, identified some hydraulic erosion and cycling mechanism problems, and confirmed superior drilling rate and lifetime performance to commerical diamond bits when drilling hard abrasive rock.

56797 (SAND—78-0670C) **Geothermal drilling and completion technology development.** Varnado, S.G.; Stoller, H.M. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780708—18). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The high cost of drilling and completing geothermal wells is an impediment to the development of geothermal energy resources. Technological deficiencies in rotary drilling techniques are evidenced when drilling geothermal wells. The Division of Geothermal Energy (DGE) of the U.S. Department of Energy has initiated a program aimed at developing new drilling and completion techniques for geothermal wells. The goals of this program are to reduce well costs by 25% by 1982 and by 50% by 1986. Sandia Laboratories has been selected to manage this technology development program, and this paper presents an overview of the program. Program justification which relates well cost to busbar energy cost and to DGE power-on-line goals is presented. Technological deficiencies in current rotary drilling techniques for geothermal wells are discussed. A program for correcting these deficiencies is described.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

56798 (LA-UR—78-904) **Hot dry rock energy extraction operations.** Hendron, R.H. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 5p. (CONF-780708—13). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

Progress in the establishment of a two-hole and connecting-fracture system on the southwest flank of the Valles Caldera in north-central New Mexico is summarized. Piping and equipment to complete the energy extraction system, the initial operation, and some brief and early interpretations of results are reported. To date the loop has run 52 days with several minor interruptions of short duration and 3 longer ones of up to 14 h. (JGB)

56799 (LA-UR—78-906) **LASL hot dry rock geothermal energy development project.** Hill, J.H. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 4p. (CONF-780708—12). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The history of the hot-dry-rock project is traced. Efforts to establish a two-hole and connecting fracture system on the south-

west flank of the Valles Caldera in north-central New Mexico are summarized. Problems encountered in drilling and hydraulic fracturing are described. Current results with the loop operation for heat extraction are encouraging, and plans for a second energy extraction hole are underway. (JBG)

GEOTHERMAL DATA AND THEORY

REFER ALSO TO CITATION(S) 56504

TIDAL POWER

ECONOMICS

56800 Status of tidal power. Shaw, T.L. (Univ. of Bristol, Eng.). *Int. Water Power Dam Constr.;* **30**: No. 6, 29-34(Jun 1978).

Now that electricity from La Rance is said by the French to be cheaper than from nuclear sources, and the Canadians are pressing ahead with their phased program for the Bay of Fundy, it seems as if this massive source of low head water power has broken through the economic barrier.

TIDAL POWER PLANTS

56801 Tidal power: problems and benefits. Benn, T. *Int. Water Power Dam Constr.;* **30**: No. 6, 27(Jun 1978).

The main points of discussion concerning the feasibility of a tidal power plant in the Severn estuary are highlighted.

56802 Re-assessing the feasibility of Fundy tidal power. Clark, R.H. (Inland Waters Directorate, Ottawa, Ont.). *Int. Water Power Dam Constr.;* **30**: No. 6, 35-41(Jun 1978).

Indications are that the tides of the Bay of Fundy can provide an economic source of renewable, pollution-free and relatively inflation-free source of energy for the Maritime Provinces of Canada, and even for the utility systems of the northeastern United States. Feasibility reassessment studies have been completed and are collated in a report (submitted in March) to the governments sponsoring the investigation.

56803 Tidal power in India. Subrahmanyam, K.S. *Int. Water Power Dam Constr.;* **30**: No. 6, 42-44(Jun 1978).

The main sources of electrical power in India are coal-fired plants, nuclear generation and hydropower. The part that tidal schemes could play in this mix are discussed, and details are given of a number of studies carried out under the auspices of the UN.

DESIGN AND OPERATION

56804 Apparatus for harnessing tidal power. Gorlov, A.M. US Patent 4,095,423. 20 Jun 1978. Filed date 5 May 1977. 6p.

An apparatus for harnessing and extracting a portion of the power generated by the rise and fall of ocean tides is described. A portion of a waterway is dammed and the difference in water levels across the dam provides a pressure differential which, through appropriate valving, feeds two sealed chambers which are used to contain air under positive pressure. The chambers are connected one each to alternate ends of a cylinder for driving a piston and rod assembly disposed therein, in reciprocating motion. The dam is comprised of a thin-walled structure which may be either rigid, conventional materials or flexible and flotationally supported.

POWER CONVERSION SYSTEMS

56805 Large bulb units for tidal power plants. Casacci, S. (Societe Neyrpic, Grenoble, France). *Int. Water Power Dam Constr.;* **30**: No. 6, 45-47(Jun 1978).

Now that considerable experience of tidal plant operation has been gained at La Rance, the author demonstrates the feasibility of producing bulb units with substantially larger runner diameters than those in use at present. Design criteria for large-dimension machinery are discussed, and ways are suggested in which the overall economics of future tidal powerplants could be improved.

WAVE ENERGY CONVERTERS

56806 Ocean motion power generating system. Jackson, A.H. US Patent 4,091,618. 30 May 1978. Filed date 14 Jun 1976. 6p.

A wave motion power generating system comprised of a floating buoy attached to a pump which pumps water from a container submerged below water level is described. The pump removes water from the container creating a hydrostatic head which can be used to draw water through a drive system for operating a power generator. The buoy may be in the form of a cylindrical ring mounted on the leg of an ocean platform with the pump being a cylindrical container also mounted on a leg well below the surface of the ocean. The motion created by ocean waves moves the buoy up and down operating the pump to create a void in a tank submerged well below the ocean surface, thus creating the hydrostatic head. This hydrostatic head can be used to drive a turbine which in turn operates a power generator.

56807 Wave 'raft' test take to the open seas. Laird, R. *Engineer (London);* **246**: No. 6370, 30-31(27 Apr 1978).

Plans are described for performance testing of a $^1/_{10}$th scale model of the a Cockerell raft wave energy converter in the open waters of the Solent.

WIND ENERGY

56808 (CONF-770921—P1, pp 183-184) **American Wind Energy Association and the wind energy industry.** Drees, H.M. (Pinson Energy Corp., Marstons Mills, MA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

In mid 1974, the American Wind Energy Association (AWEA) rose to respond to a need of the growing wind energy community, both to the industry and to the consumers. AWEA exists to promote wind as a pollutionless, renewable energy source, and to act as a clearinghouse for technical, institutional, and social issues concerning wind energy utilization. The Association is modeled after the more traditional professional organizations such as the AIAA and the AHS. However, the Association exists as a organization to provide needed services not only to the industry, but to the consumers as well.

56809 (CONF-770921—P1, pp 291-295) **Technical overview of the wind characteristics program element.** Ramsdell, J.V. (Battelle Pacific Northwest Labs., Richland, WA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Battelle, Pacific Northwest Laboratories (PNL), has been providing technical and management support for the Wind Characteristics Program Element (WCPE) of the Wind Energy Conversion Program since April 1976. Within the Wind Energy Conversion Program, the WCPE is a service element to provide planning, design and evaluation of performance of wind energy conversion systems (WECS) selection of sites for installation of WECS, and operation of WECS.

56810 (CONF-770921—P1, pp 297-306) **Wind energy statistics for large WECS arrays.** Justus, C.G.; Hargraves, W.R. (Georgia Inst. of Tech., Atlanta). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Wind power performance of large arrays of wind energy conversion systems (WECS) in four regions of the country has been studied (New England, Great Lakes, Central and Pacific Coast regions). The large arrays of WECS perform differently than a single WECS at an individual site would, especially with regard to distributions of power output and probabilities of power changes. A simple model has been developed, based on the number of WECS sites in the array and average spatial correlation across the array, which reproduces well certain of the observed array performance characteristics.

56811 (CONF-770921—P1, pp 413-418) **Public reactions to wind energy and windmill designs.** Ferber, R. (Univ. of Illinois, Urbana). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

This study, financed by the Rann Program of the National Science Foundation when the wind energy research was under NSF, was undertaken to explore reactions of the general public toward different types of wind energy devices for generating electric

energy. More specifically, the objectives of the study were two-fold: (1) to provide substantive information on public acceptance of different types of wind energy devices in different settings; and (2) to furnish a methodological base for more intensive studies of public acceptance of such devices. In connection with both of these objectives, information was also gathered on general attitudes toward wind and other forms of energy.

56812 (CONF-770921—P1, pp 467-472) **Netherlands research program on wind energy.** Piepers, G.G.; Sens, P.F. (Netherlands Energy Research Foundation, Petten). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Early 1975, a Project Evaluation Group prepared a proposal for a research program on wind energy. The government decided to execute this program, starting on March 1, 1976. The program will take 5 years and the total cost, on the 1975 price level, will be H.Fl. 15 mln. The purpose of the program is to investigate the feasibility of application of wind energy on a large scale to produce electricity, that can be fed into the existing grid. The first phase of the program, lasting until March 1, 1977, had the nature of orientation and collection and evaluation of existing information. Proposals for research and development were specified in more detail for the second phase, that runs from March 1977 until January 1979. Two basic designs were taken into consideration, i.e., a windturbine with horizontal axis and the vertical axis turbine, according to Darrieus' patent.

56813 (CONF-770921—P1, pp 474-478) **Swedish wind energy program.** Hugosson, S. (National Swedish Board for Energy Source Development, Stockholm). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Some of the results from the National Swedish Wind Energy Program are summarized. The program was initiated by the National Swedish Board for Technical Development (STU) in February 1975 and was later transferred to the National Swedish Board for Energy Source Development (NE), that was organized July 1, 1975.

56814 (CONF-770921—P2) **Proceedings of the third biennial conference and workshop on wind energy conversion systems. Volume II.** Kornreich, T.R. (ed.). (JBF Scientific Corp., Wilmington, MA (USA)). May 1978. Contract EX-76-C-01-2521. 496p. Dep. NTIS, PC A21/MF A01.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

Separate abstracts are included for 34 papers presented concerning technology development, meteorological siting considerations, multi-unit applications, and innovative and advanced systems concepts. Two papers were previously input into the energy data base.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 56834

56815 (CONF-770921—P1, pp 173-181) **Alaskan wind power.** Wentink, T. Jr. (Univ. of Alaska, Fairbanks). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

The potential and possible applications of Alaskan wind power are examined. While these may seem parochial, an important auxiliary objective always is to contribute to the National Wind Energy Program started at NSF and continued and expanded by ERDA. Progress, significant results during the last year, and applications of wind energy conversion systems (WECS) are discussed.

56816 (CONF-770921—P1, pp 209-218) **Wind energy mission analysis.** Garate, J.A. (General Electric Co., Valley Forge, PA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

The principal objectives of this study were to assess the potential for wind energy conversion systems on a national scale and to identify high potential applications for WECS. The study concentrated on board applications of WECS over large geographic areas within the continental United States. Emphasis was placed on identifying and exploring high aggregate energy users who have significant potential to utilize wind energy in place of other alternatives. Attractive applications were found to be electric utilities, residences, the paper industry, agriculture, and remote communities. For purposes of brevity, this discussion will be limited to the electric utility case, by far the largest application.

56817 (CONF-770921—P1, pp 285-287) **Application study of wind power technology to the City of Hart, Michigan.** Asmussen, J.; Park, G.L.; Krauss, O.; Curtice, D.; Linvill, D.E. (Michigan State Univ., East Lansing). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

This report summarizes the research accomplishments of contracts E(11-1)-2603 and E(11-1)-2902, entitled "Application Study of Wind Power Technology to the City of Hart, Michigan, Years I and II". These research projects evaluated the technical and economic feasibility of wind generation for the Hart, Michigan municipal utility, whose peak 1976 demand was about 4 MW. The Hart system has a number of desirable features for wind power application: (1) it is located eight miles inland from the East Coast of Lake Michigan where the average wind velocity is about 5.5 m/s, (2) it depends almost entirely on diesel generation, using gas and oil, and (3) it has a small hydro facility.

56818 (CONF-770921—P1, pp 321-331) **Technique to predict wind statistics for wind energy conversion systems in remote locations.** Vukovich, F.M.; Clayton, C.A. (Research Triangle Inst., Research Triangle Park, NC). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

A technique was developed to predict wind statistics in remote locations utilizing historical wind data from a synoptic weather station, wind field simulations from a primitive equation model, and a statistical model. The results suggest that reasonable predictions of wind statistics can be achieved provided good parameterization of the hydrodynamic model is accomplished. The major source of error in the overall methodology was due to the discreet nature of the control data available at the synoptic weather station. Significant error was also due to the failure of the simulated and actual data to produce compatible parameter estimates. The error due to the statistical modeling procedures was insignificant.

56819 (CONF-770921—P1, pp 381-387) **Coastal zone wind energy.** Garstang, M. (Univ. of Virginia, Charlottesville). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

An important part of the coastal zone wind energy study being carried out at the University of Virginia is to determine the velocity field in the lowest 100 meters of the atmosphere along a line which is normal to the coast extending landward and seaward. The coastline from Maine to Texas is being considered in the U.Va. study. Determination of the low level velocity field as a function of height and distance normal to the shore at every point along this coastline would not be practical. To deal with this difficulty, times and regions along the coast with common wind regimes are determined. A simplified 2-dimensional model in each region is used. Results obtained using the 2-dimensional model for one of the five regions of the East and Gulf Coast are presented.

56820 (CONF-770921—P1, pp 456-466) **Wind energy potential in New Zealand: aspects of the resource assessment and its utilisation.** Lindley, D.; Chin, S.W. (Univ. of Canterbury, Christchurch, New Zealand). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

A wind energy resource survey of New Zealand is briefly described while computations of capacity factor for several wind turbine designs demonstrate a simple way of assessing specific output given only the annual mean wind speed for the site. Comparisons are made of power demand versus wind energy availability on a diurnal and seasonal basis for New Zealand's four largest population centers and some preliminary work on the measurement of wind structure and topographical effects as they affect turbine design and performance is described.

56821 (CONF-770921—P2, pp 563-572) **Engineering handbook on the atmospheric environmental guidelines for use in wind turbine generator development.** Frost, W. (Univ. of Tennessee Space Inst., Tullahoma). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The purpose of the handbook is to provide in an engineering format the atmospheric design inputs for wind energy conversion machines. The handbook does not address the problem of siting wind turbine generators but provides inputs for structural and dynamic analyses such as data on wind loading, turbulence level, snow and ice loadings, etc. Since wind is the more important design parameter, four sections have been devoted to wind under the following classifications: wind speed, wind shear, turbulence and wind direction. Also, a complete section has been devoted to ice and snow loadings because of their importance to the structural design of the wind turbine generator. Finally, a section has been devoted to climatological factors such as precipitation, temperature and other environmental parameters which are of importance but to a lesser degree in the design of wind energy conversion machines.

56822 (SAND—78-0548C) **Availability of wind power.** Reed, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 15p. (CONF-780253—1). Dep. NTIS, PC A02/MF A01.

From Eletrobras/sudene seminar; Recife, Brazil (13 Feb 1978).

Meteorological studies of available wind power were begun at Sandia in 1973 to support the development of a vertical-axis wind turbine (VAWT, "egg-beater"). This presentation reviews work to date. Copies of seven source reports were provided to ELETROBRAS; Scientia, Ltda., has included them in an extensive bibliography that was distributed at the seminar. This report summarizes those climatological studies that are needed to assist and promote wind energy exploitation in Brazil.

REGULATIONS

56823 (CONF-770921—P1, pp 393-397) **Some legal-institutional implications of Wind Energy Conversion Systems.** Mayo, L.H. (George Washington Univ., Washington, DC). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

WECS presents legal-institutional questions which are, to a degree, similar to those encountered with other types of unconventional energy systems—direct solar, ocean thermal, etc. But certain unique features relevant to WECS such as the variability of wind speed and direction, the need for unobstructed wind flow paths, and the unusual space requirements for certain potential WECS installations have special legal-institutional implications.

ECONOMICS

REFER ALSO TO CITATION(S) 56816, 56817, 56855, 56869

56824 (CONF-770921—P1, pp 202-204) **Some practical technical and economical aspects of small wind power systems (summary).** Hughes, W.L. (Oklahoma State Univ., Stillwater). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Performance characteristics and cost estimates for small wind power systems are described.

56825 (CONF-770921—P1, pp 222-233) **Assessment of the potential for using large wind turbines in New England.** Johanson, E.E.; Goldenblatt, M.K. (JBF Scientific Corp., Wilmington, MA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Presented is a description of a generic planning process for evaluating the feasibility of WECS as part of the future power generating mix of a utility. The description is sufficiently generic so that it can be used either by electric utilities that are participants in a pooling arrangement or utilities that have stand alone operations. To insure the compatibility of the plan with current utility practices, the Planning Department of the New England Gas and Electric Association (NEGEA) and the management of New England Power Pool's (NEPOOL) operations unit (NEPEX) were involved in the development of the methodology. Although the planning process of NEGEA and the operational environment of NEPOOL are not necessarily identical to other utilities, the factors and basic process that utilities must consider when evaluating WECS will be similar to those presented.

56826 (CONF-770921—P1, pp 237-248) **Wind energy systems applications in Hawaii.** Lindley, C.A.; Melton, W.C. (Aerospace Corp., El Segundo, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

The present study contract is intended to assess the potential for application of Wind Energy Conversion Systems (WECS) for application on Oahu, and to generalize to generically similar situations elsewhere, as a guide to ERDA's future design and application planning. At this reporting, the study is not complete.

56827 (CONF-770921—P1, pp 251-261) **Minnesota utility application.** Lindquist, O.H. (Honeywell Systems and Research Center, Minneapolis); Malver, F.S.; Overom, L.D. May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The decision to introduce a significant Wind Energy Conversion System (WECS) into a utility requires that management conclude the system is technically acceptable and financially viable. Utility planners need a method of evaluating the technology compatible to their current planning methods. This study was directed toward understanding this planning-decision process and defining the technical and financial issues which must be addressed prior to a large-scale application of WECS as an energy alternative. The overall objective of this study was to assess current WECS viability for a utility application and to define the attributes and performance requirements of a system capable of yielding a satisfactory return on investment to a utility company.

56828 (CONF-770921—P1, pp 273-281) **Summary of current cost estimates of large wind energy systems.** Johanson, E.E. (JBF Scientific Corp., Wilmington, MA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The Federal Wind Energy Program has funded a number of studies to examine WECS economics and potential utilization on a national and regional basis. These studies include two machine design efforts, two mission analyses, and four regional analyses. In addition, the costs for the second GE Mod 1 machine, from the original contract, are presented. This paper is a summary of the study conducted by JBF Scientific Corporation to pull together the results of these eight studies in the area of large wind energy system economics and put them on a common economic basis for comparison purposes.

56829 (CONF-770921—P1, pp 444-454) **Integration of wind energy in national energy supply systems: comparison of conventional and wind power plants.** Jarass, L. (Univ. of Regensburg, Ger.). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

A method is proposed to evaluate the performance of alternative power generating technologies and assume for simplicity that the power demand exceeds the entire production of the considered individual power plant at all times. The cost of investment of conventional power plants is mainly determined by the installed power in KW. The expression "cost of investment per KW" in combination with "cost of operation per KWh" is therefore a good measure for the comparison of conventional power plants. The cost of investment of wind power plants, however, is mainly determined by the size of the rotor (i.e., the area). The installed power has only a marginal influence. The comparison of conventional power plants and wind power plants is of special interest. For this comparison there is no simple measure of comparison as "cost per KW" or "cost per KWh" or "cost per m^2". New measures of performance are proposed which are called firm capacity (FCW) of a wind power plant, which is comparable to the installed capacity of a conventional power plant.

56830 (CONF-770921—P2, pp 723-725) **Technical and economic aspects of wind generation in electric utility systems.** Marsh, W.D. (General Electric Co., Schenectady, NY). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The overall objectives of this study were to perform technical and economic analyses of a wide range of wind energy systems (WES) as they would be expected to perform if installed in a specific electric utility system in the year 1990. To that end, several specific objectives were defined: (1) develop a methodology for evaluating WES generation capability as an integral part of an electric utility system; (2) exercise the methodology in a real electric utility system to evaluate a number of alternative WES designs; (3) estimate the value of WES capability in a real electric utility system; (4) recommend R and D activities to achieve viability of WES generation on electric utility systems; and (5) estimate penetrations and associated impacts if viability is achieved.

56831 (CONF-770921—P2, pp 767-773) **Efforts on the economic analysis of Darrieus vertical-axis wind turbine systems.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

As part of the vertical-axis wind turbine program at Sandia Laboratories, there have been efforts to understand the economics of the Darrieus turbine in the utility grid (constant rpm) application. There are two major objectives to these efforts. The first objective is to provide tools to permit an economic basis for making fundamental design decisions. Such decisions include, for example, the choice of the "best" operating rpm, number of blades, rotor solidity, turbine height to diameter ratio, etc. The second objective is to estimate what the absolute cost of such systems will be, so that there is a basis for deciding whether or not further development of the concept is desirable.

ENVIRONMENTAL ASPECTS

56832 (CONF-770921—P1, pp 402-404) **Wind energy conversion: environmental effects assessment.** Rogers, S.E. (Battelle Columbus Labs., OH). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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A biophysical impact assessment was undertaken to evaluate the possible environmental effects of the emerging wind energy conversion technology. Specific field studies were done at the ERDA/NASA 100 kW Experimental Wind Turbine near Sandusky, Ohio (NASA Lewis Research Center's Plum Brook Station). Operational constraints on the 100 kW WTG have limited the turbine to approximately 3 hours of operation at design conditions and less than 250 hours total rotation time (typically one-half design speed, no load). This constraint on our research affected the depth of our explanation of causality. The experimental data indicate that the WTG results in minimal effect to the physical environment.

56833 (CONF-770921—P1, pp 407-408) **Electromagnetic interference to TV reception caused by windmills.** Sengupta, D.L.; Senior, T.B.A. (Univ. of Michigan, Ann Arbor). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The paper investigates the interference to TV reception caused by the scattering of TV signals by windmills. In the vicinity of an appropriately oriented windmill, a TV receiver will receive the windmill scattered signals in addition to the direct signals. The scattering by the rotating blades of the windmill will produce both amplitude and phase modulations of the signals at the receiver; in practice the former effects dominate. The main objective of the study is to: (i) determine if such interference exists, (ii) quantify the levels of interference found, and (iii) assess the impact of these levels on the siting of windmills. To meet these objectives a rather comprehensive program was developed involving laboratory measurements and simulation, field testing using the existing windmill at the NASA/Plum Brook Facility, and rigorous analyses and computations.

WIND ENERGY ENGINEERING

APPLICATIONS

REFER ALSO TO CITATION(S) 56826

56834 (CONF-770921—P1, pp 107-113) **Proposed conceptual plan for integration of wind turbine generators with a hydroelectric system.** Hightower, S.J.; Watts, A.W. (Dept. of the Interior, Denver). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

A comprehensive study of the performance, cost, and marketing aspects of a large windpower system integrated with an existing hydroelectric network has been accomplished by the Bureau of Reclamation for a high wind region in southern Wyoming. An overview of the proposed conceptual plan is shown. Approximately 49 wind turbines would be installed in an array at a site near Medicine Bow, Wyoming, one of the windiest areas in the United States. Power output from the wind turbines would be integrated with the existing hydroelectric system within the Colorado River Storage Project (CRSP), which serves as the energy storage system, and has facilities to regenerate the capacity and energy in a prescribed pattern as determined by the marketing plan.

56835 (CONF-770921—P1, pp 141-153) **Wind power uses in agriculture.** Liljedahl, L.A. (Agricultural Research Service, Beltsville, MD). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Qualitative review of power and energy using operations in agriculture have identified irrigation pumping, building heating, and product processing and storage as possible candidates for the use of wind power in agriculture. Experimental studies to test these applications and identify operating problems are described.

56836 (CONF-770921—P1, pp 185-196) **Wind power for space heating.** Cromack, D.E.; Heronemus, W.E. (Univ. of Massachusetts, Amherst). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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One of the most cost effective applications for wind power is thought to be for space heating. A brief description is presented of the UMass Wind Furnace, the design and construction aspects along with a discussion of the preliminary component tests and initial operational experience. The Wind Furnace will be demonstrated under fully automatic operation during the 1977-1978 heating season.

56837 (CONF-770921—P1, pp 262-272) **Wind machines for the California Aqueduct.** Lindley, C.A. (Aerospace Corp., El Segundo, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The California Aqueduct is a 648 mile long water system that captures and stores surplus water from the state's northern mountain regions and delivers it to the central and southern arid regions for agriculture, industry, and urban uses. This study was initiated in the hope that a major water pumping job would prove a natural match for the intermittent supply of energy available from the wind. There was some concern whether an adequate wind resource could be found in the area.

56838 (CONF-770921—P2, pp 552-561) **Feasibility of pre-stressed concrete rotor blades for wind turbines.** Furlong, D.B. (Tuthill Pump Co. of California, San Rafael). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The feasibility of pre-stressed concrete as a material for wind turbine blades is being studied under Contract NAS3-20596. A concrete blade for a 125-foot diameter rotor has been designed and compared with the aluminum alloy blades now in operation at Plumbrook. The concrete blades are about twice the weight of aluminum blades, but are stiffer to provide the same bending vibration frequencies. The centrifugal forces on concrete blades are twice as much, but the coning angle can be reduced so that bending moments from centrifugal forces neutralize those from normal airloads. The cyclical chordwise gravity loads are proportional to blade weights, but the blades are much stronger in the chordwise bending direction, so that airload bending in the beam direction produces higher stresses. Fabrication technique follows conventional pre-stressed concrete practice. The goal of the project was to develop a blade with a recurring cost of under $15,000. The projected costs of the concrete blade achieve this goal. Tooling costs are also very low in comparison to aircraft practice. Detailed cost estimates have been made for all blade parts. Studies of tower modifications required for the heavier blades are in progress.

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 56824

56839 (CONF-770921—P1, pp 131-135) **Systems development and test center activities in the wind systems program at Rocky Flats.** Moment, R.L. (Rockwell International, Golden, CO). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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In May of 1976, the Energy Research and Development Administration (ERDA) announced award of a contract to Rockwell International, Rocky Flats Plant for providing "Technical and Management Support for the Development of Wind Systems for Farm and Rural Use". The overall objective of this program is to stimulate manufacture of Small Wind Energy Conversion Systems (SWECS) by the private sector and utilization of these systems by the public. To meet the overall objectives of this program two major areas of effort are planned. The first one is to establish and operate a national Wind Systems Test Center where SWECS would be tested, thereby helping to establish the current state of the technology and to evaluate technology improvements. Funding necessary research and development to advance the technology and assist evolution of more economical and reliable SWECS is the second major activity. Activities in both the areas of test center establishment and funding of technology development programs are described.

56840 (CONF-770921—P1, pp 156-168) **Analysis of the economics of current small wind energy systems.** Kornreich, T.R.; Tompkins, D.M. (JBF Scientific Corp., Arlington, VA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Wind energy conversion systems with power ratings of 15 KW or less, referred to as small WECS, have been sold for several years by manufacturers in Europe and the United States. In recent years, due to cost increases and uncertainties in the supplies of fossil fuels, additional manufacturers have entered this field. The ERDA Wind Systems Branch is carrying out tests of existing small WECS, development of new designs and planning for methods to expand the commercial manufacture and utilization of small WECS. This report presents a review of the performance and economics of currently available small WECS and provides an indication of how well these systems compete with alternative energy sources in certain applications at today's technology and commercial status. It should be pointed out that WECS costs do not include the effects of R and D which might lead to better machines as measured by performance and cost.

56841 (CONF-770921—P1, pp 423-428) **Wind energy research in Canada.** Templin, R.J. (National Research Council, Ottawa). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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In the current fiscal year, about $500,000 has been allotted for wind energy R and D, to be dispensed by the National Research Council, the designated lead agency in the field of renewable energy research. A rough guess at the total national expenditure, including that by industry, is probably not more than $2,000,000 per year at the present time. Federal funding for 1978-1979 is not yet determined.

56842 (CONF-770921—P1, pp 432-436) **Danish wind energy program.** Johansson, M. (DEFU, the Research Association of the Danish Electricity Supply Undertakings, Lyngby). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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A number of assessments and studies, mostly concerning the economical possibilities, and some practical experiments have been carried out. A two years development program for larger Wind Turbine Generators (WTGs) was initiated by the government in December 1976. This program is the first stage of a large program, which should clarify the question of a possible exploitation of wind power in the Danish electricity supply system. The two years program is sponsored with 14.260.000 kr. (2.400.000$) by the ministry of Commerce and with 3.000.000 kr. (500.000$) by the electric utilities, who are also managing the program.

56843 (CONF-770921—P1, pp 438-441) **Wind energy R and D program of the Federal Republic of Germany and main lines of development.** Neumann, R.; Windheim, R. (Kernforschungsanlage, Juelich, Ger.). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The Wind Energy R and D Program of the Federal Republic of Germany, part of the government's Energy R and D Program, follows two lines: (1) adaption of small WECS with horizontal or vertical axis to special uses (e.g., island operation, developing countries); and (2) electricity generation by large WECS for the national grid: the GROWIAN Program. The activities of the first line on small WECS will be explained only briefly in this report, whereas the important second line on large WECS will be described in more detail.

56844 (CONF-770921—P1, pp 480-487) **Wind energy test plant operation: results and findings.** Gustavsson, B. (SAAB-SCANIA AB, Linkoeping, Sweden). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The 75 kW test plant is part of the National Swedish Wind Energy Program managed by the National Swedish Board for Energy Source Development (NE). The contract for development and construction was placed at Saab-Scania in the beginning of 1976. Erection was completed in March, 1977. Since April 1977 the test plant has undergone a delivery test program. The results and findings from these tests are described.

56845 (CONF-770921—P2, pp 491-501) **Technology development overview.** Cahill, T.P. (Lewis Research Center, Cleveland). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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A description is presented of a number of technology development projects that ERDA is funding. Some of the significant results to date and, if the project is a continuing effort, future plans are presented. An overview is presented of the project structure, tasks and objectives which will be pursued during fiscal year 1978, depending on available funding and ERDA final approval. The studies and projects discussed are those that have been identified as a result of the experience gained to date. As more data and experience are gained, the SR and T plan will be modified if required to provide new or changing emphasis in support of the evolving experience of overall wind turbine development.

56846 (CONF-770921—P2, pp 517-529) **Aeroelastic response and stability of horizontal axis wind turbines.** Friedmann, P.P. (Univ. of California, Los Angeles). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Some current research being done at UCLA, under NASA Grant NSG 3082 funded by NASA Lewis Research Center, on aeroelastic effects in large wind turbines is reviewed.

56847 (CONF-770921—P2, pp 528-537) **150 ft wind turbine blade.** Gewehr, H.W. (Kaman Aerospace Corp., Bloomfield, CT). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The objective of the 150 ft wind turbine blade program is to demonstrate that current design and fabrication methods are capable of producing a blade of this size, and have the potential for low cost manufacture of such blades in production quantities. The program includes design, fabrication, test and evaluation of one 150 ft long prototype test blade. The blade design and its fabrication, and a brief summary of loads, stresses and natural frequencies obtained during the preliminary design analysis are included. The 150 ft blade program is under NASA Lewis Research Center Contract NAS3-20600 to Kaman Aerospace Corporation. The blade spar will be fabricated by Structural Composites Industries, Inc., Azusa, California, under a Kaman subcontract.

56848 (CONF-770921—P2, pp 540-549) **Composite blades for Mod-0.** Rothman, E.A. (Hamilton Standard, Windsor Locks, CT). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The technical feasibility of wind-powered generator systems in the power range of 100 KW has been demonstrated. A prototype

fiberglass blade was designed, built, and ground-tested under a contract from NASA/Lewis Research Center to Hamilton Standard. A brief summary of the blade fabrication and testing is presented.

56849 (CONF-770921—P2, pp 574-582) **Design trade-offs as influenced by rotor, tower, and drive dynamics.** Miller, R.H.; Dugundji, J.; Martinez-Sanchez, M. (Massachusetts Inst. of Tech., Cambridge). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The work being performed under the present ERDA contract is a continuation of a research program conducted last year and originally initiated under NSF grant. The results of the previous investigation covered: development of a method for analyzing wind turbine aerodynamics in the presence of wind shear; development of a theory for the dynamics of a coupled wind turbine/synchronous alternator; and a method for analyzing the aeroelastic stability of a rotor in the presence of gusts and other large disturbances. The research now being reported builds on this analytical basis and is primarily concerned with reducing these complex analyses to a form in which they can be readily used for trade-off analyses.

56850 (CONF-770921—P2, pp 584-593) **Darrieus rotor aerodynamics.** Wilson, R.E. (Oregon State Univ., Corvallis). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Oregon State University in partnership with Aerovironment has been engaged in the development of performance analysis of wind powered machines since 1973. The Darrieus rotor aerodynamic characteristics are described.

56851 (CONF-770921—P2, pp 595-601) **Development of dynamic inducer rotor systems.** Lissaman, P.B.S.; Walker, S.N. (AeroVironment Inc., Pasadena, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The concept of using tipvanes (small wings attached at right angles to the rotor-tips with their span approximately parallel to the free-stream) to increase the power extraction of a wind turbine was first introduced by Van Holten (1974). The idea is that if the mean flow through a turbine disc is increased, then there is the potential of extracting more mechanical energy. The tipvane concept is at an exploratory stage. The current research is funded under ERDA Contract EG-77-C-06-1021 and involves theoretical studies designed to estimate the performance and optimal geometry of tipvanes, preliminary engineering estimates of system cost benefits, and field testing of a number of different tipvanes on an instrumented two meter propeller type wind turbine mounted on a moving platform.

56852 (CONF-770921—P2, pp 603-609) **Investigation of dynamic and structural characteristics of rotors for wind energy conversion.** Doman, G.S. (Boeing Vertol Co., West Chester, PA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The structural dynamics of rotors for horizontal-axis wind-turbine systems interact with the tower and with the driven-system elements. Aerodynamic blade loadings are unsteady and are greatly influenced by blade flapping and bending motions that can occur in the large rotors which are needed for electrical utility applications. To optimize large systems for fatigue-related behavior, and cost-effectiveness requires good aeroelastic design. This in turn requires study of the complete dynamic system in a manner which is feasible only by simulation in adequate computer programs. Seeking to explore the design of large systems in an engineering effort which made use of existing analytical programs and techniques within the helicopter industry, ERDA awarded a contract to the Boeing Vertol Company in June 1975. Originally a one-year program, it was later extended to two years with an expanded scope. The program final report is summarized.

56853 (CONF-770921—P2, pp 612-621) **Summary of the design of a self-regulating wind turbine.** Spierings, P.A.M.; Cheney, M.C. (United Technologies Research Center, East Hartford, CT). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The concept of the composite bearingless rotor, such as used in some helicopters for reasons of weight, cost and simplicity, is shown feasible for wind turbines. Self alignment with the wind direction and self regulation with the wind velocity were demonstrated in wind tunnel tests of a 4.5 ft diameter dynamically scaled model. The model consisted of a hub supported pendulum integrated with the blade to make blade pitch a function of rotor speed. The effects of scale on the concept were studied in the design of a 40-ft diameter wind turbine. For this 5 kW (at 12 mph) machine, results of performance tradeoff studies, stress analysis of the blade and tower structure, and a stability investigation are presented. Engineering drawings of the complete system have been prepared which could lead to full-scale fabrication and demonstration.

56854 (CONF-770921—P2, pp 624-630) **Nonpotential aerodynamics for windmills in shear-winds.** Preuss, R.D.; Smolka, S.A.; Suciu, E.O.; Morino, L. (Boston Univ.). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Presented is a summary of research performed for the development of computer programs designed for studying three dimensional nonpotential incompressible steady and unsteady flow around complex horizontal-axis windmill configurations.

56855 (CONF-770921—P2, pp 712-721) **Offshore wind energy conversion systems: preview of a feasibility study.** Kilar, L.A. (Westinghouse Electric Corp., East Pittsburgh, PA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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In August 1976, the Advanced Systems Technology Division of Westinghouse Power Systems Company initiated work on an ERDA-sponsored study to assess the technical feasibility and costs of multi-unit wind energy conversion systems sited in the U.S. offshore (ERDA Contract No. E(49-18)-2330). Subcontractors for the 14-month investigation are Global Marine Development Incorporated, Oceanographic Services Incorporated, Kaman Aerospace Corporation and Westinghouse Research Labs. Public Service Electric and Gas of New Jersey and the Institute of Gas Technology are contributing as consultants. This paper presents highlights of the first 12 months of the study. All findings presented are preliminary in nature and subject to revision.

56856 (CONF-770921—P2, pp 745-756) **Vertical axis wind turbine program.** Braasch, R.H. (Sandia Labs., Albuquerque, NM). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The 17 meter research turbine achieved operational status on March 29, 1977. The construction of this machine was shown during the conference presentation with the aid of a motion picture film sequence. A block diagram indicating the equipment associated with the machine is presented. The machine will be tested with one, two, or three blades with or without blade support struts. The turbine can be tested at thirteen different rotor rotational rates. These turbine speeds are listed. The machine is currently being tested with two blades and support struts.

56857 (CONF-770921—P2, pp 759-766) **Topics on the dynamics of vertical axis wind turbines.** Reuter, R.C. Jr. (Sandia Labs., Albuquerque, NM). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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Rotating machinery components are generally examined closely for dynamic problems because of ever present, periodic, body and/or external forces. Darrieus vertical axis wind turbines, with their long, slender blades, rotating shafts and tie-down cables are no exception. Relatively low operating frequencies and multiple frequency excitation forces make vibrations and dynamic instabilities of VAWTs a constant concern to the designer. This paper briefly discusses several dynamics problems that were treated with a view toward influencing design and operation of the Sandia 17 Meter VAWT, presently operating in Albuquerque, New Mexico.

56858 (CONF-770921—P2, pp 775-781) **Giromill wind tunnel test and analysis.** Brulle, R.V. (McDonnell Aircraft Co., St. Louis). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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The feasibility of the Giromill as a viable wind energy conversion system was verified by the initial one year feasibility study

completed in May 1976. The design, fabrication, and testing of a Giromill model in a wind tunnel are described. The primary objective of the test was to verify that the Larsen cyclogiro theoretically computed performance was obtainable. A secondary objective was to obtain a comparison of Giromill performance with that of other types of vertical axis machines.

56859 (CONF-770921—P2, pp 784-793) **Circulation controlled vertical axis wind turbine.** Walters, R.E.; Migliore, P.G. (West Virginia Univ., Morgantown). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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This NSF/ERDA study started in 1975. The major emphasis has been to theoretically and experimentally investigate the aerodynamic performance and structural requirements of a straight-bladed vertical axis wind turbine (VAWT). System and cost studies are included. Of particular interest is the evaluation of high-lift, variable blade pitch, circulation-controlled (c.c.) airfoils. Current funding is by ERDA contract EY-76-C-05-5135. Technical personnel of the Allegany Ballistics Laboratory (ABL) of Hercules, Inc., are cooperating with WVU on the structural, systems, and cost studies.

56860 (CONF-770921—P2, pp 794-802) **Betz type limits for vortex wind machines.** Loth, J.L. (West Virginia Univ., Morgantown). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

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In a shrouded wind turbine the local high inviscid wind velocity increases the maximum obtainable power as derived by Betz. In the search for smaller and more powerful wind machines, the use of a vortex, to create a region of low pressure and high velocity has been considered by several investigators. The theoretical maximum power coefficient of two vortex ingesting wind turbine configurations have been computed. In addition two wind turbine configurations, which use the low pressure in the vortex core to exhaust into, have also been analyzed.

56861 (CONF-770921—P2, pp 803-807) **Vortex augmentors.** Sforza, P.M. (Polytechnic Inst. of New York, Farmingdale, NY). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

A discussion of research, design and development on aerodynamic devices which can concentrate and augment natural winds is presented. The keystone element is the generation and control of discrete vortices of high power density by the appropriate interaction of suitably designed aerodynamic surfaces with natural winds of relatively low power density. Properly designed turbines are utilized to transform the energy in this compacted vortex field to useful shaft work. This idea is termed the Vortex Augmentor Concept.

56862 (CONF-770921—P2, pp 808-817) **Summary of recent progress on tornado-type wind energy system.** Yen, J.T. (Grumman Aerospace Corp., Bethpage, NY). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The Tornado-Type Wind Energy System is one of several Advanced and Inovative Concepts being investigated under ERDA's Wind Energy Program as potential ways to reduce the cost and broaden the usability of wind energy. This system uses a large hollow tower to form an internal vortex, and the low pressure at the core of the tower provides an effective and low-pressure exhaust reservoir for the turbine, which accepts a separate ram air inlet supply. Analytical investigations of several very challenging fluid mechanical problems are being carried out, but it will be some time before all of the flow processes involved will be well known enough to yield a highly accurate analytical prediction of performance and to greatly improve existing scaling laws. A variety of wind tunnel models have been designed and built and some testing at small scale has been conducted using screens to simulate the turbines.

56863 (CONF-770921—P2, pp 819-826) **Progress report on the diffuser augmented wind turbine.** Oman, R.A.; Foreman, K.M.; Gilbert, B.L. (Grumman Aerospace Corp., Bethpage, NY). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

Grumman Aerospace has been investigating cost-effective diffusers to obtain augmented power from wind turbines. The primary aspects of the problem that have been examined in this work are: design concepts and aerodynamic performance of compact diffusers; and the comparative economics of power produced by diffuser-augmented wind turbines (DAWT) to those of conventional, horizontal axis, wind energy conversion systems (WECS). The basic technical feasibility of the DAWT concept has been experimentally confirmed, and a rational case for DAWT economic viability in the 50 to 100 KW and MW power rating ranges presented. A 46 cm (18 in.) diameter turbine will soon be tested in the baseline diffuser configuration.

56864 (CONF-770921—P2, pp 829-840) **Evaluation of the Madaras Rotor Power Plant concept.** Whitford, D.H.; Minardi, J.E.; West, B.S. (Univ. of Dayton, OH). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

This paper describes some of the work accomplished in the University of Dayton's in-house studies conducted over the last two years and those conducted during the first six months of our current one-year program sponsored by ERDA as a part of the Federal Wind Energy Program. The objective of this program is to demonstrate the degree that Madaras power plants having capacities in the 10 MW to 100 MW range are cost competitive with horizontal-axis wind generators and fossil-fuel-fired power plants.

56865 (CONF-770921—P2, pp 843-852) **Progress in electrofluid dynamic (EFD) wind driven generator research.** Minardi, J.E.; Lawson, M.O. (Univ. of Dayton, OH). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The Electrofluid Dynamic (EFD) wind driven generator directly converts wind energy to electrical energy without moving parts except possibly for diverting it into the wind. In an EFD generator charges of one polarity are seeded into a flowing neutral gas. Viscous interactions drive the charged particles against an electrical potential and produce dc power. Typically, the EFD generator uses high voltages and low current densities. The high voltage power supply places the attractor electrode at a high voltage relative to the colloid producing mechanism. Charged colloid particles of one sign produced by the charging system are swept past the attractor electrode by the moving air towards the collector electrode. The collector voltage depends on the load and current, but the charged particles must be driven up a potential hill by the neutral particles of the moving air. Thus, electrical power is generated directly by the moving air with no moving parts required. The feedback control system senses the voltage on the collector and adjusts the attractor voltage, thereby controlling the output current in order to hold the output voltage constant.

56866 (CONF-770921—P2, pp 854-863) **Charged aerosol wind/electric power generator.** Marks, A.M. (Marks Polarized Corp., Whitestone, NY). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The Wind/Electric Power Generator is a charged aerosol electrogasdynamic generator at atmospheric pressure which is powered directly by the wind. It comprises a large area electrode screen of special construction mounted in a vertical plane to intercept the wind, which emits charged water droplets into the wind stream as a wind/electric power transducer. Wind/Electric Power Generators will be installed at suitable geographical locations (updrafts at mountain ranges, along seashore fronts, etc.) where there is a steady flow of air in one direction in the 5 to 20m/sec velocity range. Assuming a wind velocity of 10 m/sec, the wind power converted to electric power is 0.45 kW/m^2. A Charged Aerosol Wind/Electric Power Research and Development program relates to the direct conversion of wind power to electric power through the medium of charged water droplets. Theoretical and experimental work was done to determine an efficient charging method.

56867 (CONF-770921—P2, pp 865-870) **Energy from humid air.** Oliver, T.K.; Groves, W.N.; Gruber, C.L.; Cheung, A. (South Dakota School of Mines and Tech., Rapid City). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

This is a summary of results to date of a research project which is in progress at the South Dakota School of Mines and Technology. The goal of the research is to find a cost-effective process to convert the energy in humid air into mechanical work, which will be used to drive an electrical generator. A vast amount of

energy is contained in the latent heat of vaporization of the water vapor in humid air. If the water vapor is made to condense, the latent heat is released into the surrounding air. The mechanizations for converting the energy in humid air which are being considered in this project can be thought of as heat engines in which the air itself serves as the working fluid. The research is being carried out primarily by computer modeling.

56868 (DOE/NASA/1004—78/13) **DOE/NASA Mod-0A wind turbine performance.** Richards, T.R.; Neustadter, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EX-76-A-29-1004. 9p. (CONF-780801—23; NASA-TM—78916). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

As part of the national wind energy program under the direction of the Department of Energy, the NASA-Lewis Research Center has designed and built, and is now operating, a large wind turbine at Clayton, New Mexico. Designated the Mod-0A-1, this is the first of three identical 200 kW wind turbines to be operated on electric utility networks. This machine was installed at Clayton, New Mexico, in November 1977. A comparison between its predicted and measured power versus wind speed performance is presented.

56869 (MTR—7485(Vol.6)) **Systems descriptions and engineering costs for solar-related technologies. Volme VI. Wind Energy Conversion Systems (WECS).** Miller, G. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 127p. Dep. NTIS, PC A07/MF A01.

A study of the technologic and economic characteristics of Wind Energy Conversion Systems (WECS) was carried out for the Solar Energy Division of the U.S. Energy Research and Development Administration (ERDA). Basic technologic data including component descriptions, costs and resource requirements are presented for several designed and proposed WECS units including General Electric 500 and 1500 kW units, Kaman Aerospace 500 and 1500 kW units, a METREK proposed 1500 kW unit and a METREK proposed 1500 kW unit for low wind regions. The data are based primarily on previous design studies carried out under the auspices of the Wind Energy Office of ERDA by General Electric Space Systems Division and Kaman Aerospace.

56870 (PNL-SA—6739) **Flow field analysis.** Cliff, W.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 16 Jan 1978. Contract EY-76-C-06-1830. 9p. (CONF-780153—1). Dep. NTIS, PC A02/MF A01.

From Symposium on structural of wind turbines; Cleveland, OH, USA (30 Jan 1978).

The average mean wind speed integrated over a disk is shown to be extremely close to the mean value of wind speed which would be measured at the center of a disk for most geometries in which a WECS (Wind Energy Conversion System) would operate. Field test results are presented which compare instantaneous records of wind speed integrated over a disk with the wind speed measured at the center of the disk. The wind field that a rotating element would experience is presented which has been synthesized from the outputs of an array of anemometers.

POWER CONVERSION SYSTEMS

56871 (CONF-770921—P2, pp 697-707) **System dynmics of multi-unit wind energy conversion systems application.** Macklis, S.L. (General Electric Co., Valley Forge, PA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

This project, which is concerned with the effect of WECS on the stability of an interconnected electrical power system, was initiated in July, 1976, and will be concluded in October, 1977. The study was performed under the cognizance of Mr. Donald Teague of the Wind Energy Branch, ERDA. The purpose of the study is to provide design information for the WECS machine and for the electrical utility power system interface which would allow a significant number of WECS to be incorporated into the power system. The basic ingredients of the study are wind characteristics, WTG machine characteristics, protection and control for both the WECS and the utility and representative power system characteristics. A specific goal is to determine the feasibility and constraints of installing numerous WECS either in a group or scattered throughout the power system.

56872 (CONF-770921—P2, pp 728-739) **Loss of load probability and capacity credit calculations for WECS.** Melton, W.C. (Aerospace Corp., El Segundo, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The net conclusion in discussions of WECS implementations has often been that the installation of a WECS will not displace the installation of any amount of conventional capacity. However, using the same generating system reliability indices that utility planners rely on, it can be shown that typical WECS installations will indeed increase the overall system reliability and, therefore, that there is some conventional capacity displacement due to WECS. To do this credibly requires that the index be an hourly index and that the WECS forced outage rate depend on both time of day and time of year. A method of calculating the capacity equivalency of a WECS using Loss of Load Probability (LOLP) as the index is explained and an example in the context of the Oahu system of the Hawaiian Electric Company is presented.

SITE CHARACTERISTICS

56873 (CONF-770921—P1, pp 335-345) **Biological wind prospecting.** Hewson, E.W.; Wade, J.W. (Oregon State Univ., Corvallis). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

The objective of biological wind prospecting is to develop methods of using wind deformed vegetation for selecting optimum sites for utilization of wind energy. Five different indices of wind effects on trees have been developed and are being calibrated in terms of various wind characteristics.

56874 (CONF-770921—P1, pp 349-358) **Effect of atmospheric density stratification on wind turbine siting.** Agopian, K.G.; Crow, S.C. (Poseidon Research, Los Angeles). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

The power available from the wind varies as the cube of the wind speed, so the performance of a wind turbine depends critically on its location. The phenomena governing the distribution of winds are listed in order of decreasing horizontal scales. Wind distributions are greatly influenced by local topography having horizontal scales of tens of kilometers, so the flow field is dominated by atmospheric density stratification. The objective of this study is to develop a simple and accurate method for computing the location of maximum wind velocity over a given terrain based on the linear theory of stratified atmospheric flow.

56875 (CONF-770921—P1, pp 361-370) **Stochastic considerations in site survey design.** Corotis, R.B. (Northwestern Univ., Evanston, IL). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. I.

Statistical analysis procedures and probability models that are applicable to wind energy conversion sites in general are developed. Special computer algorithms are used to study variances, fit probability distributions, analyze run duration, and determine correlation structure in the wind.

56876 (CONF-770921—P2, pp 635-645) **Site selection techniques and methodologies for WECS.** Drake, R.L. (Battelle Pacific Northwest Labs., Richland, WA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The question of siting a wind energy conversion system, or systems (WECS), represents a balance between economic and technical criteria and the environmental and social values of the user and the local citizens, whether the WECS is for a small farm or a utility serving a multi-state region. The technical siting issues include the meteorological characteristics of the candidate site that contribute to the efficient and safe production of power by wind, the potential weather hazards of the site in question, and the terrain and seismic features of the site. These technical issues are highly related to the size and type of the proposed WECS and the type of storage system (if there is one) required for the installation. A good siting policy is one that optimizes the power output based on the constraints imposed by these various issues.

56877 (CONF-770921—P2, pp 646-652) **Influence of hill shape on wind characteristics over two dimensional hills.** Bouwmeester, R.J.B.; Meroney, R.N.; Sandborn, V.A.; Rider, M.A. (Colorado State Univ., Fort Collins). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

Since June 1975 the Fluid Mechanics and Wind Engineering Program at Colorado State University has been engaged in a three-year research project to determine which locations are most favorable for wind-power installations. Wind-tunnel modeling techniques are used to analyze systematically the effect of characteristic topographical features on different flow regimes. The research which is primarily experimental includes evaluation of wind characteristics over simple two-dimensional and three-dimensional shaped hills with different upstream flow conditions.

56878 (CONF-770921—P2, pp 654-663) **Technology development for assessment of small-scale terrain effects on available wind energy.** Frost, W.; Nowak, D. (FWG Associates, Inc., Tullahoma, TN). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The purpose of the research being conducted under ERDA contract E(45-1)-2443 is to establish guidelines and gather information pertaining to the siting of wind turbine generators relative to small-scale terrain features. The information collected is interpreted and presented in an engineering manual. The manual has the title Technology Development for Assessment of Small-Scale Terrain Effects on Available Wind Energy. A three-year program is being carried out. The first year effort will include the effect of two-dimensional terrain features on wind turbine siting. The major contents of the manual are listed.

56879 (CONF-770921—P2, pp 677-686) **Utility of mathematical windfield models in a WECS siting methodology: a case study.** Traci, R.M.; Phillips, G.T.; Patnaik, P.C.; Freeman, B.E. (Science Applications, Inc., La Jolla, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

An important link in the chain of activities for developing practical wind energy conversion systems (WECS) is the prospecting or site selection activity for identifying optimum locations for WECS siting. Present techniques rely on meteorological records, which are often unavailable for the most promising sites, and meteorologists' "rules of thumb." Such techniques have been inadequate in the past. Thus, the main goal of the present program is to provide an improved siting methodology which makes use of mathematical windfield modeling to accurately extrapolate climatological data from a given site (or sites) in a region of interest to other potentially "windier" sites throughout the region.

56880 (CONF-770921—P2, pp 689-692) **Assessing the local wind field for siting.** MacCready, P. (AeroVironment Inc., Pasadena, CA). May 1978.

From 3. biennial wind energy conversion systems conference; Washington, DC, USA (19 Sep 1977).

In Proceedings of the third biennial conference and workshop on wind energy conversion systems. Vol. II.

The best wind monitoring device for complex terrain would be some sort of remote monitor which continuously defines the entire three-dimensional flow field from ground to 100 m throughout a hilly region of, say, 5 km by 5 km. None exists. Fixed towers with instruments are expensive to install and operate; microwave and laser Doppler systems suffer from the same problems, and, in complex terrain, also suffer from the requirement that multiple single-ended systems must be used to define a single vector; Tethersondes are awkward or impossible to use in the strong winds of greatest interest and are inconvenient for unattended operation. Doppler acoustic radar seems to represent the best compromise. It has been developed over the past few years by several government, university, and industrial laboratories to provide indirect monitoring of wind profiles. One such system, developed by AeroVironment Inc. (AV) primarily for real-time monitoring of the capability of the atmosphere to disperse pollutants up to 500 m, was available for adaptation to this task. This report describes a program to determine if Doppler acoustic wind measurements provide adequate data and are operationally satisfactory for wind generator siting. The program included actual field experience in acquiring acoustic wind data in complex terrain.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 57101, 57102, 57106

56881 (DOE/EIA—0057) **Plant and ownership list. Supplementary to the maps entitled principal electric facilities, 1978, based on data to June 30, 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 94p. Dep. NTIS, PC A05/MF A01.

Tabulated data are presented for locating U.S. power plants on previously published maps entitled "Principal Electric Facilities 1978." In addition to map number and location coordinates, the power plants in each state are identified by name, regional electrical reliability council area, MW capacity, type of power unit, and name of owner. (LCL)

56882 **Proceedings of the American power conference. Volume 39.** Chicago; Illinois Inst. of Technology (1977). 1351p. (CONF-770403—). $30.00.

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A separate abstract was prepared for each of 123 papers for Energy Research Abstracts (ERA); 25 of these were also selected for Energy Abstracts for Policy Analysis (EAPA). Seven of the papers were considered out of scope, and 16 papers were processed previously. (MCW)

56883 **New National Electrical Safety Code: ANSI C2.** Denbrock, F.A. (Gilbert/Commonwealth, Jackson, MI). *Proc. Am. Power Conf.;* **39**: 1169-1182(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

An attempt is made in this paper to collect, in one source, a brief review of the National Electrical Safety Code (NESC) history, the consensus standards methods used in its adoption, a review of the many significant change highlights in the latest edition and a consideration of future aspects in the development of the NESC. Some examples of changes in the 1977 edition are illustrated. However, time and space do not permit a detailed section-by-section, rule-by-rule review.

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 57105

56884 **Thermal power plant.** Pfenninger, H. (to BBC Brown Boveri and Co., Ltd.). US Patent 4,095,419. 20 Jun 1978. Priority date 8 Apr 1975, Switzerland. 6p.

A thermal power plant is described that has a thermal prime mover and a supercharged gas generator for generating producer gas from coal which, following separation of fly ash and sulfur, serves as fuel for the power plant. A charging group for the gas generator consists of coupled air compressor and gas turbine units, the compressor unit providing compressed air for operating the supercharged gas generator and the gas turbine unit being driven by unburned producer gas from the output of the supercharged gas generator, and a dry dust collector for the fly ash is incorporated in the flow path of the producer gas either ahead of the charging gas turbine or just after the first row of its moving blading. In order to also remove the sulfur content from the producer gas, an injector for a reagent which chemically binds the sulfur is provided in the flow path of the producer gas between the supercharged gas generator and the dry dust collector whereby the chemically bound sulfur is then removed from the producer gas together with the fly ash in the dry dust collector.

56885 **Thermal power engineering: results of development and scientific and technological problems.** Zhimerin, D.G.; Dobrokhotov, V.I. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 1-8(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 9-16(1977).

A history is given of the technological development of fossil-fuel and nuclear power production in the USSR during the last 60 years. Topics discussed include: the reliability and efficiency of generating units; the combined production of heat and power; nuclear reactor development; use of low grade fuels; and MHD generators. (PMA)

56886 **Development of power engineering in Siberia and the Far East.** Storozhuk, K.S. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 33-35(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 70-72(1977).

A brief history is given of the development of power generating systems in the eastern USSR. Topics discussed include hydroelectric power plants, thermal power stations, co-generation, and power transmission systems. Future growth plans are discussed. (PMA)

56887 Cooperation of Comecon countries in the power engineering field. Oborotov, A.G. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 38-40(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 74-76(1977).

The current status and future plans of the Comecon countries with respect to the development of power industries are outlined. Topics discussed include EHV power transmission systems, district heating systems, thermal power plants, and hydroelectric power plants. (PMA)

56888 Community of power specialists and technical progress. Ryzhnev, Yu.L. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 41-43(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 77-79(1977).

A discussion is given on the purpose and recent efforts of SEPIS, the Scientific-Engineering Power Industry Society of the USSR. The society organizes scientific and engineering conferences on different problems in power and electrical engineering, takes part in development of long range plans for the development of fuel and power, works on particular proposals and recommendations with regard to speeding up the rate and increasing the volume of electrification of the USSR both for a five-year and a longer period; conducts republican, regional and all-Union inspections of plans for new technology, which with establishment of public control promotes successful fulfillment of these plans.

56889 San Miguel Project. Gee, L.S. (Tippett and Gee, Inc., Abilene, TX). *Proc. Am. Power Conf.;* **39**: 416-432(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The San Miguel Plant is a mine-mouth electric power complex located near San Antonio, designed to burn very low grade Texas lignite. The first 400 MW unit is scheduled to begin operation in Dec. 1979. The testing, fuel characteristics, mining, and pulverizing of the on-site fuel, the design of the power generating equipment and the power plant auxiliary equipment, i.e., cooling system, waste handling system, pollution control equipment, and control system are described. The San Miguel Plant is of international interest since it will burn the lowest quality coal ever considered for a large power station in the US. (LCL)

56890 Design and implementation of the San Diego Gas and Electric Company waste water treatment system. Peltier, R.V. (San Diego Gas and Electric Co., CA); Brenman, J.E. *Proc. Am. Power Conf.;* **39**: 875-888(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Methods and procedures used by San Diego Gas and Electric Company, their consulting engineers and equipment suppliers in arriving at the optimum waste water treatment system design for meeting the NPDES permit obligations are presented. Pilot-plant and bench-scale studies on representative waste samples and how they were used in process selection and ultimate equipment and mechanical systems design are discussed. Individual operations such as clarification, filtration, sludge thickening and dewatering are discussed. Discussion of the use of caustic or lime for chemical treatment and the effect on equipment performance is also included.

56891 Design of waste-water-treatment facilities for the Detroit Edison Company. Kaercher, G.C. (Detroit Edison Co., MI); Rosain, R.M. *Proc. Am. Power Conf.;* **39**: 889-895(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design, operation, and costs of 9 waste water treatment facilities being constructed by the Detroit Edison Co. so that discharged fossil-fuel power plant waste waters will meet EPA regulations are described. (LCL)

56892 San Juan Station water management program. Dascher, R.E. (Public Service Co., Albuquerque, NM); Lepper, F.R. Jr. *Proc. Am. Power Conf.;* **39**: 896-908(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design, performance and economics of the Waste Water Recovery System used at the coal-fired San Juan power plant in New Mexico are discussed. This waste processing system has a vapor-compression evaporator, a reverse osmosis unit, and uses several pretreatment processes ahead of the evaporator. The composition of the wastes, performance testing of the process components, and operating costs are described. This power plant has been able to significantly reduce its consumption by the recycling of its waste water. (LCL)

56893 Treating secondary sewage for water use at an air-cooled power plant. Bydalek, H. (Stone and Webster Engineering Corp., Boston); Kroon, J.F.; Seekamp, A.H. *Proc. Am. Power Conf.;* **39**: 925-933(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The 330MW Wyodak Plant near Gillette, Wyo. is the world's largest air-cooled power plant and the largest plant to use secondary sewage treatment effluent as the primary source of water for all uses except domestic supply. These uses include ash sluicing, fire protection, auxiliary cooling, and boiler cycle makeup, with each use requiring different treatments. The water treatments used to reduce organic matter, suspended and dissolved solids included chlorination, filtration, reverse osmosis and demineralization. This system's performance has shown the feasibility of using sewage treatment effluent as a reliable water source for power plants. (LCL)

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 56940

56894 (BNWL-SA—6506) **Advanced dry and dry—wet cooling towers.** Johnson, B.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-06-1830. 27p. (CONF-7709151—1). Dep. NTIS, MF A01.

From Symposium on power plant heat rejection; Washington, DC, USA (12 Sep 1977).

Portions of document are illegible.

Although progressive restrictions on the use of fresh water for power plant cooling and the growing use of dry cooling is anticipated in many regions of the country, the transition to this form of cooling will occur slowly unless improved technology leads to lower cost systems. The need for supplemental power during periods of warm weather contribute to the high cost of dry cooling and have led to greater emphasis on combined dry and wet cooling. Experimental and demonstration programs are underway at several locations in the U.S. to develop new systems which will hopefully reduce the cost of dry and wet/dry systems and/or the need for supplemental power. If any of the projected improvements of these advanced systems can be developed to the point of commercial availability, the use of dry cooling would be greatly increased and many of the secondary benefits will be realized. These include greater freedom to take advantage of existing transmission corridors, multiple plants on presently water-limited sites and mine mount sites in water-limited regions. The more promising advanced concepts under study are reviewed and appraised as to their likelihood of having a significant impact on the future use of dry (including dry/wet) cooling.

56895 (PNL—2498) **Description and cost analysis of a deluge dry/wet cooling system.** Wiles, L.E.; Bamberger, J.A.; Braun, D.J.; Braun, D.J.; Faletti, D.W.; Willingham, C.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 224p. Dep. NTIS, PC A10/MF A01.

The use of combined dry/wet cooling systems for large base-load power plants offers the potential for significant water savings as compared to evaporatively cooled power plants and significant cost savings in comparison to dry cooled power plants. The results of a detailed engineering and cost study of one type of dry/wet cooling system are described. In the "deluge" dry/wet cooling method, a finned-tube heat exchanger is designed to operate in the dry mode up to a given ambient temperature. To avoid the degradation of performance for higher ambient temperatures, water (the delugeate) is distributed over a portion of the heat exchanger surface to enhance the cooling process by evaporation. The deluge system used in this study is termed the HOETERV system. The HOETERV deluge system uses a horizontal-tube, vertical-plate-finned heat exchanger. The delugeate is distributed at the top of the heat exchanger and is allowed to fall by gravity in a thin film on the face of the plate fin. Ammonia is used as the indirect heat transfer medium between the turbine exhaust steam and the ambient air. Steam is condensed by boiling ammonia in a condenser/reboiler. The ammonia is condensed in the heat exchanger by inducing airflow over the plate fins. Various design parameters of the cooling system have been studied to evaluate their impact on the optimum cooling system design and the power-plant/utility-system interface. Annual water availability was the most significant design parameter. Others included site meteorology, heat exchanger configuration and air flow, number and size of towers, fan system design, and turbine operation. It was concluded from this study that the HOETERV deluge system of dry/wet cooling, using ammonia as an intermediate heat transfer medium, offers the potential for significant cost savings compared

with all-dry cooling, while achieving substantially reduced water consumption as compared to an evaporatively cooled power plant. (LCL)

56896 Cooling tower, construction method method therefor and precast prestressed concrete building units. Lin, T.Y.; Yang, Y.C. (to T. Y. Lin International). US Patent 4,092,811. 6 Jun 1978. Filed date 14 Feb 1977. 20p.

A large, thin-shell cooling tower, a method for its erection, and novel precast units are described. Upon a foundation a series of angularly-extending columns is erected, and the columns are joined at their upper ends by a lower ring. Then a ribbed, waffle-like reinforced concrete wall is constructed to extend up from the lower ring and to provide a shell with a shape such as a hyperbolic paraboloid. The ribbed outer (or inner) surface strengthens the structure while enabling the thickness of the portions in between the ribs to be relatively thin. A series of vertically-spaced horizontal circumferential reinforcing bars or post-tensioning cables and a series of horizontally-spaced vertical or inclined bars or cables are included in the wall. The wall is preferably made up from a series of precast units that are of novel structure in themselves. At the top of the wall is an upper ring joining the various elements together.

56897 Acquisition and analysis of thermal-performance data on a natural-draft cooling tower. Wilber, K.R. (Environmental Systems Corp., Knoxville, TN); Carey, R.P. *Proc. Am. Power Conf.;* **39**: 685-690(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

State-of-the-art measuring instruments and techniques used to obtain thermal performance data on a natural draft cooling tower are described. These data were used to estimate the thermal capability of the tower and the results were compared with tower performance estimates based only on design specifications and tower characteristics. It was concluded that automated data acquisition techniques can easily and accurately acquire cooling tower thermal performance data and that a mechanism for determining expected tower capability based only on tower design, construction, and specified design conditions has been demonstrated. (LCL)

56898 Crosswind and internal flow characteristics of dry cooling towers. Russell, C.M.B. (C-E Lummus Heat Transfer Division, London); Jones, T.V.; Holder, D.W.; McChesney, H.R.; Verlinden, M. *Proc. Am. Power Conf.;* **39**: 709-718(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Experiments are described which were performed to determine how the arrangement of heat exchanger bundles at the base of a natural draft dry cooling tower affects the tower's internal flow and its sensitivity to crosswinds. Model towers with heat exchanger bundles represented by gauze screens were used in tests with no crosswinds at high Re numbers and with crosswind effects at low Re numbers in a 2m x 4m wind tunnel. The model results were compared with real cooling tower data. The experiments and comparisons with the full-scale towers suggest that crosswind effects are smallest when the intake arrangement creates the minimum disturbance to the oncoming wind. The arrangements tested all had similar equivalent heat transfer areas and, thus, the overall performance in still air should be similar for each design. However, the radial layouts and, in particular, the concentric layout, offer superior performance characteristics in crosswinds. These comments apply to towers that are symmetrical about their axes so that crosswind effects are the same for all wind directions. If the wind direction is generally constant it should be possible to design so that the effect of a crosswind on performance is favorable. (LCL)

56899 Duke Power Company ash basin equivalency demonstration for metal cleaning wastes. Haller, W.A.; Harwood, J.E.; Mayne, S.T.; Gnilka, A. (Duke Power Co., Charlotte, NC). *Proc. Am. Power Conf.;* **39**: 868-874(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The cleaning of power plant boiler tubes to remove scale produces a metal cleaning waste whose composition depends on the boiler metallurgy, scale composition, and the scale solvent used. This metal-containing liquid waste must be treated prior to disposal in order to comply with EPA Effluent Guideline limits. Duke Power has been treating metal cleaning wastes in active ash basins for 2 years. The studies conducted to determine the chemical and physical processes involved in this waste treatment are discussed. Treatment in the active ash basin reduced the Fe, Cu, Zn, and Ni concentrations in the metal cleaning wastes to below 1 mg/l. (LCL)

56900 Assessment of intermittent and continuous chlorination and bromochlorination schemes for control of estuarine fouling organisms in once-through cooling systems. Burton, D.T. (Academy of Natural Sciences, Benedict, MD). *Proc. Am. Power Conf.;* **39**: 934-942(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The objectives of this study were: to test various intermittent and continuous chlorination and bromochlorination schemes for antifoulant control in once-through cooling systems of plants located in estuarine waters; to compare the effectiveness of the two biocides at the same concentrations; and to test the two-hour discharge limitations of the Environmental Protection Agency's (EPA) Effluent Guidelines and Standards for Steam Electric Power Generating Source Categories. The materials and methods used are described. No significant difference in the control of estuarine fouling organisms was found on the average between similar concentrations of chlorine and bromine chloride. Significant differences in fouling were found between intermittent and continuous halogenation on both clean and prefouled surfaces. Continuous halogenation was more effective over the entire fouling season in controlling primary, secondary and adventitious fouling communities than intermittent halogenation for periods up to two hours per day. Continuous halogenation at 0.3 mg/l total residual halogen was more effective than 0.1 mg/l total residual halogen during late spring and summer; no difference was found between the two concentrations during the early fall. Unfortunately, continuous halogenation does not meet the present requirements of EPA's effluent limitations.

POWER CYCLES

REFER ALSO TO CITATION(S) 56357

56901 (FE—1806-46) **Development of high temperature turbine subsystem technology to a "technology readiness status": Phase II. Progress report for May, 1978.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 9 Jun 1978. Contract EX-76-C-01-1806. 45p. Dep. NTIS, PC A03/MF A01.

Long lead items such as pumps and the blast gate valve for the Hot Gas Path Development Test Stand (HGPDTS) have been ordered. Additional bidders are being sought for the heat exchangers. Work has been started on the stack design. Final definition drawings for the test stand are nearly complete. Satisfactory progress is being made on facility installation and checkout. Drawings for the new Turbine Simulator test section pressure casing and water cooled transition piece have been completed and fabrication has begun. Modification to the existing test stand hardware is underway. Drawings for the heat transfer test specimen are in process. C. F. Braun has completed the detailed design of the PGCUS (Pilot Gas Clean Up System) and has submitted a definitive cost estimate for the construction. The study of partial channel horizontal passage flow in the One-g Flow Facility has been completed. Test specimens for the high speed rotating heat transfer tests in the Motorized Rig are nearly complete. A design review of the Air Turbine Tests was conducted. Modifications to the Liquid and Gas fueled Combined Cycle Power Plant descriptions (OPDD's) are enumerated. A three bearing machine configuration has been selected for the Technology Readiness Vehicle (TRV). The permissible alignment envelope for the selected configuration has been developed. Minor changes to the sectoral combustor transfer and staging design points are being reviewed as a result of the latest machine cycle data. Liner slot tests are nearly complete. Fabrication of the pressure drop model will begin shortly. Progress on the combustor shell casting has been satisfactory. Details of the design, manufacture, materials and process development status for each stage of the turbine (nozzles and buckets) are presented. Detailed status of the technology support tasks are also presented.

56902 (FE—2685-08) **Case study applications of venture analysis. Eighth monthly report, April and May 1978.** (Thermo Electron Corp., Waltham, MA (USA)). Jun 1978. Contract EX-77-C-01-2685. 32p. Dep. NTIS, PC A03/MF A01.

This is the eighth monthly progress report for "Case Study Applications of Venture Analysis." The case studies to be performed are for: (1) a steam Rankine system producing electric power from waste heat (performed first), and (2) a coal derived fuel-fired diesel. The Draft Report for Case Study No. 1 has been completed. Work is continuing on the second case study. The capital costs for coal and coal-derived fuel-fired diesels are given for systems from a few megawatts to 1000 megawatts. Synthetic fuels and the economics of their manufacture are discussed. Competing technologies for central station utility applications are outlined.

56903 Ultra-high temperature gas turbine for coal-derived fuels, with maximum fuels flexibility. Day, W.H. (General Electric Co., Schenectady, NY). *Proc. Am. Power Conf.;* **39**: 524-537(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Research and development on water-cooled gas turbines has been underway for 16 yr at General Electric. It is expected that in another 5 yr technology readiness will be demonstrated for a water-

cooled utility-size gas turbine with a base-load firing temperature of 2600°F using coal-derived fuel. The characteristics of a power plant using this technology are described. Information is included on water cooling; combustor development; gas turbine design; and development and economics of ultrahigh temperature combined cycle with integrated coal gasification system. (LCL)

56904 Small-utility experience with supplementary-fired combined-cycle power generation. Waite, R.B. (Taunton Municipal Lighting Plant, MA). *Proc. Am. Power Conf.;* **39**: 563-568(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The Taunton Municipal Lighting Plant consists of two generating stations with a total net capability of 167 MW in six generating units. Of this capacity, 105 MW is generated by one supplementary-fired, combined-cycle unit. The design, operation, economics, thermal efficiency, and performance of the combined-cycle unit which has been operating since Oct. 1976 are discussed. From this operating experience it was concluded that the combined-cycle concept, when properly executed, is an outstanding industry development. The cycle is somewhat simpler than that of a conventional steam plant of the same size, it is a very efficient cycle, and it is fairly simple to operate when supplementary firing and auxiliary forced-draft fans are included. The combined-cycle concept is recommended to other small utilities that are looking for a means of obtaining the efficiency of a large generating unit while avoiding the large size involved. (LCL)

COMPONENTS

REFER ALSO TO CITATION(S) 56467, 56901, 56903, 56944, 56956, 56968, 56981, 57142

56905 (FE—1765-43) **High temperature gas turbine engine component materials testing program: Task I. Annual report for 1977.** Sims, C.T. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 15 Mar 1978. Contract EX-76-C-01-1765. 175p. Dep. NTIS, PC A08/MF A01.

The objective of this program is to provide a data base for performance of gas turbine nozzle and bucket materials in coal-derived liquid (CDL) and low-Btu gas environments at temperatures up to 2200°F. This report covers accomplishments during the year 1977, the last 12 months of the 30 month effort. Activity consists of "Initial Tests" to define the problems, "Screening Tests" to evaluate a range of high-temperature materials, and "Confirmation Tests" to evaluate the best materials and cooling design under realistic conditions. The report gives results of totals of 345 h of testing in simulated industrial-size gas turbine rig testing in CDL, and 210 h in low Btu gas. Various levels of ash and alkali metal content were studied in the CDL test. Results of corrosion, fouling and system performance are given. Similarly, low Btu gas combustion was investigated through the "Initial" and "Confirmation" test stages with industrial-size systems being evaluated for performance, corrosion and fouling. The latter test was for 55 h, utilizing an air-cooled nozzle cascade, a gas cleanup system and the GEGAS low-Btu gasifier.

56906 (FE—2465-5) **Erosion study in turbomachinery affected by coal and ash particles: Phase 1. Annual progress report, August 31, 1976—September 30, 1977.** Tabakoff, W. (Cincinnati Univ., OH (USA). Dept. of Aerospace Engineering and Applied Mechanics). Jan 1978. Contract EX-76-C-01-2465. 95p. Dep. NTIS, PC A05/MF A01.

In many industrial and military applications the erosive action of high speed particles results in serious problems in areas as diverse as gas turbines, nozzles, transport tubes, coal-fired boiler systems, catalytic cracking equipment, and others. Historically, erosion has been studied as a two part problem. The first part involves a determination from the flow conditions of the number, direction and velocity of the particles striking the surface. With such information available, the second part of the problem involves the calculation of the surface material removed. These two problems have always been considered to be independent of one another; however, in the complicated flow fields existing within rotating machinery, it is questionable whether this assumption is valid. The problem of predicting erosion in rotating machinery is even more complex and has not been satisfactorily discussed in the literature. This complexity is primarily a result of the fact that the particle trajectory must be traced through the flow field after multiple impacts. As a starting point, a review of the literature is undertaken which leads to the present state of knowledge relating to erosion and the trajectory of small particles. This survey will provide the necessary background for the study to follow. In addition, the present report describes the test facility which is designed in such a way that the aerodynamic effects are an integral part of the erosion test parameters. Some results from the alloys studied (aluminum, stainless steel, and titanium) in this investigation are reported.

56907 (TID—28570/1) **Preliminary design and cost estimate for an atmospheric fluidized bed steam generator.** (Fluidized Combustion Co., New York (USA)). Apr 1978. Contract EF-77-A-01-6013. 597p. Dep. NTIS, PC A25/MF A01.

In late 1976, the Tennessee Valley Authority issued invitations to propose for the preliminary design and cost estimate of a near atmospheric fluidized-bed (AFB) steam generator for demonstrating the commercial application of the fluidized-bed process for utility power plants. In accordance with a contract agreement effective January 31, 1977, Fluidized Combustion Co. (FCC) has prepared a preliminary design and cost estimate for a 150 to 250 MW demonstration unit, justifying its selection of a demonstration unit design by showing conceptually how the demonstration unit would translate into a 600 to 1000 MW commercial atmospheric fluidized-bed power plant. FCC's conceptual design of a 150 MW Demonstration Atmospheric Fluidized Bed Steam Generator, utilizing a supercritical once-thru cycle, is presented. Included are estimates of capital and operating costs, schedules for completing a demonstration unit within TVA's timetable, environmental considerations, and identification of design and performance uncertainties. Based upon the results of the demonstration unit design efforts, a commercial unit conceptual design was developed and conceptual arrangement drawings were prepared. The results of this study indicate that a fluidized-bed steam generator for utility application is viable and can be designed, constructed and operated economically and competitively with systems relying on scrubbers for SO_2 removal. This volume contains the exective summary, background material on fluidized-bed combustion technology and AFB steam generator design, and the selection and characteristics of equipment for an AFB demonstration plant.

56908 (TID—28570/2) **Preliminary design and cost estimate for an atmospheric fluidized bed steam generator.** (Fluidized Combustion Co., New York (USA)). Apr 1978. Contract EF-77-A-01-6013. 363p. Dep. NTIS, PC A16/MF A01.

In late 1976, the Tennessee Valley Authority issued invitations to propose for the preliminary design and cost estimate of a near atmospheric fluidized bed (AFB) steam generator for demonstrating the commercial application of the fluidized-bed process for utility power plants. In accordance with a contract agreement effective January 31, 1977, Fluidized Combustion Company (FCC) has prepared a preliminary design and cost estimate for a 150 to 250 MW demonstration unit, justifying its selection of a demonstration unit design by showing conceptually how the demonstration unit would translate into a 600 to 1000 MW commercial atmospheric fluidized bed power plant. FCC's conceptual design of a 150 MW demonstration, atmospheric fluidized bed steam generator, utilizing a supercritical once-thru cycle, is presented. Included are estimates of capital and operating costs, schedules for completing a demonstration unit within TVA's timetable, environmental considerations, and identification of design and performance uncertainties. Based upon the results of the demonstration unit design efforts, a commercial unit conceptual design was developed and conceptual arrangement drawings were prepared. The results of this study indicate that a fluidized bed steam generator for utility application is viable and can be designed, constructed and operated economically and competitively with systems relying on scrubbers for SO_2 removal. This volume contains information on AFB combustion research, the design, performance, and cost of a 600 MW AFB steam generator, a program schedule, discussion of environmental and safety considerations, AFB steam generator and system drawing for both 150 MW and 600 MW plants, and a bibliography. (LCL)

56909 (TID—28598) **Preliminary design study for a fluidized bed demonstration unit. Final report.** (Combustion Engineering, Inc., Windsor, CT (USA)). 1 Jun 1978. Contract EF-77-A-01-6013. 327p. Dep. NTIS, MF A01.

Portions of document are illegible.

Work performed in the preliminary design study of an atmospheric fluidized bed combustion (AFBC) demonstration unit is described. This work included: selection of design parameters; selection of a conceptual boiler design; preliminary design and cost estimate of a demonstration unit and of a commercial unit; definition of areas requiring development in the demonstration unit design; and environmental assessment of the demonstration unit.

56910 Method and apparatus for set point control for steam temperatures for start-up of the turbine and steam generator in unit power plants. Bloch, H.; Salm, M. (to BBC Brown Boveri and Company Ltd.). US Patent 4,091,450. 23 May 1978. Priority date 28 Jan 1976, Switzerland. 6p.

A method and apparatus are described for controlling the set point for steam temperatures for cold start-up of a steam generator-turbine unit wherein inlet steam temperature and turbine load absorption are steadily and substantially simultaneously increased in

accordance with a predetermined relationship so as to reach their final values substantially synchronously.

56911 Synchronous machine stability using composite governor and voltage regulator models. Limebeer, D.J.N.; Harley, R.G. (Univ. of Natal, Durban, South Africa). *Electr. Power Syst. Res.;* **1**: No. 2, 97-111(Apr 1978).

Most designers neglect the effect of the governor loop when selecting a suitable voltage regulator transfer function and gain of a turbogenerator. However, with modern fast acting governors, this could lead to unwanted interloop interference and oscillations. This paper investigates the steady state and transient stability limits of such a synchronous turbogenerator using analogue governor and voltage regulator loops similar to those found on large machines (30 to 750 MW). It proposes a design technique which optimizes the gains of the two loops on the basis of maximum steady state stability. Results obtained by measurement on a special micro-machine laboratory simulation are presented. These agree closely with predicted values based upon the well-known two-axis theory of synchronous machines.

56912 Describing-function analysis of automatic generation control system with governor deadband. Wu, F.F.; Dea, V.S. (Univ. of California, Berkeley). *Electr. Power Syst. Res.;* **1**: No. 2, 113-116(Apr 1978).

A describing-function method is applied to the study of the existence and behavior of limit cycles observed in power systems. A parameter sensitivity study was conducted on a system model of an isolated area. Results on the qualitative behavior of parameter changes are presented.

56913 Study of slagging in and blowout of P-59 boiler furnace screens during the burning of Moscow-area coal. Guzenko, S.I.; Vasil'ev, V.V.; Serebryanikov, N.I.; Panchenko, V.F.; Meelak, Kh.O.; Khaikin, I.B.; Perevezentsev, V.P. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 142-145(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 18-20(Mar 1978).

The operation of the burners of the P-59 boilers at the Ryazan GRES, burning Moscow area brown coal, is characterized by intense slagging of the LRP screens, especially in the zone of maximum heat formation, causing a particularly severe screen cleaning problem. The thermal efficiency of screen cleaning by steam blowout using OM-0.35 devices is low even with intense use (every 2 hours), which is accompanied by dangerous steam-ash erosion of the tubes. Water blowout of the LRP [lower radiative part] of the P-59 boiler with four long-range M-3A devices is rather effective. Under conditions of intense formation of deposits on the screens of the lower radiative part of P-59 boilers they cannot be brought up to an operationally clean state using known cleaning methods.

56914 Tests of the circulation in the side and back screens of the advance model BKZ-420-140 NGM gas-tight boiler. Shchetkin, V.S. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 146-148(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 21-23(Mar 1978).

The circulation rates and water consumption rates in the screens of a heat and power plant are close to the calculated levels with the exception of the back part of side screen panel No. 2. Measurements of the steam output of the saline section at boiler load of 450 t/hr (front part of side screen panel No. 2) proved to be 12% below the calculated level. The circulation rate in the saline section slightly exceeds the calculated (6.3 as opposed to 5.9 according to calculation). On increase of the boiler load over 250 t/hr the circulation rates and water velocities in back screen panel No. 2 do not increase, which is connected with the high thermal load of this screen.

56915 Protecting boiler low-temperature heating surfaces with anti-corrosion coatings. Abdurashitov, Sh.R.; Zaitsev, G.A.; Deev, I.V. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 149-152(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 24-27(Mar 1978).

Industrial tests of protective coatings on boiler air preheaters and gas systems showed good protective properties of bakelite coating with proper application and thermal processing, low strength of organosilicon coatings FG-9 and VN-30, and high strength of gunite coatings based on cement and water glass.

56916 Main trends in designing the electrical part of thermal power plants. Krikunchik, A.B. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 157-164(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 32-38(Mar 1978).

A discussion is given of the technical progress in the area of designing the electrical part of large thermal power plants. The increase in the unit capacity of the generating equipment and the capacity of the individual power plants, the use of higher voltages for transmission of capacity, the creation of large combined power systems, and the improvement of equipment connection circuitry are discussed. Topics covered include: (1) turbogenerators; (2) turbogenerator excitation systems; (3) power transformers; (4) electrical connection circuits; (5) distribution units; (6) current conductors; (7) electric motors; (8) protection, control, and regulation equipment; (9) cable equipment; and (10) communications.

56917 Exchange of practical experience. Tupitsyn, S.P.; Garyaev, G.A. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 184-187(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 65-67(Mar 1978).

In order to determine the Bailu load limit for heat at which slag-free operation is provided, the allowable temperatures of the medium through the steam-water system and economical boiler unit operation, a series of tests were made at loads of 500 t/hr, 525 t/hr, 540 t/hr, and 556 t/hr. The thermal conditions of the furnace were monitored and the local thermal loads were monitored with height of the screens by TsKTI heat probes. It was shown that the blower and ventilation equipment and the pulverized fuel system meet the conditions of normal boiler operation at overloads up to the tested level of 556 t/hr, providing high economy and an allowable temperature level through the superheater system. At boiler unit overload up to 530 to 540 t/hr the falling thermal flux on the back screen during operation on pulverized fuel and a mixture of pulverized fuel with oil (10% by heat) is about 520 x 10^3 W/M^2 in the zone of maximum heat emission.

56918 Using functional redundancy of information to solve monitoring and diagnosis problems in the automatic control system of a generating unit. Fridman, L.I. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 44-49(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 89-93(1977).

The introduction of automated systems of control of production processes (PPACS) to different industries has become one of the decisive factors in the successful development of the national economy. The main trend in the development of PPACS at present is improving the structure of the systems, as well as extending and complicating the functions given to them, which leads to considerable increase in the demands made on the efficiency of control systems, first of all on their reliability. Methods are examined of solving the monitoring and diagnosis problems in the PPACS by means of rationally using the redundancy of primary information on the production process.

56919 Will large turbine-generators of the future require superconducting-field turbogenerators. Joyce, J.S. (Allis-Chalmers Power Systems, Inc., West Allis, WI); Engelke, W.; Lambrecht, D. *Proc. Am. Power Conf.;* **39**: 255-269(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The potential for the development of much larger turbines and generators for future power plants employing improved, but conventional, technology is discussed. The world-wide research and development efforts in superconducting generators with special reference to the Kraftwerk Union/Siemens program are described, and the benefits of such generators for future bulk power generation are evaluated.

56920 Inspection and evaluation of in-service turbine rotor forgings. Timo, D.P.; Placek, R.J. (General Electric Co., Schenectady, NY). *Proc. Am. Power Conf.;* **39**: 270-281(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

In-service steam turbine rotor inspection programs that have been conducted and are currently being conducted are described. The reasons for initiating these programs, the results to date, and a summary of the procedure for evaluating in-service rotors are presented.

56921 Large-scale testing for improved turbine reliability. Steltz, W.G.; Rosard, D.D.; Maedel, P.H. Jr.; Bannister, R.L. (Westinghouse Electric Corp., Lester, PA). *Proc. Am. Power Conf.;* **39**: 282-293(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Industry's largest steam turbine test facility was placed in operation by Westinghouse Electric Corporation during the fourth quarter of 1975 at the Chester Station of the Philadelphia Electric Company. This new low-pressure steam turbine laboratory provides a significant improvement in testing capability over an existing scale model facility. Size, power absorption, and flow-passing capabilities have been increased substantially, allowing full-size 3600 r/min low-pressure turbine configurations to be experimentally evaluated. Actual powerplant operating conditions are duplicated in this low-pressure steam turbine laboratory to verify new low-pressure turbine designs for mechanical reliability and efficiency. To date, the tests conducted in the low-pressure steam turbine laboratory have produced significant technical data and have defined the operating characteristics of the facility. The knowledge obtained has expanded

our technology base and will contribute to the achievement of early low-pressure turbine design maturity.

56922 Operating experience with bypass systems in fossil and nuclear power plants. Reinhard, K. (Brown, Boveri and Cie, Ltd., Baden, Switzerland); Schatzmann, G.; Stys, Z.S. *Proc. Am. Power Conf.;* **39**: 294-299(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design and operation of a steam bypass system which permits operation flexibility and availability of power plants by handling the difference between generated and consumed stem flows during transient operating conditions are described. The bypass control equipment, performance of the system in the Austrian power plant, and advantages in stabilizing boiler operation, improved steam temperature control, less erosion, and full utilization of the turbine flexibility are discussed. (LCL)

56923 Latest developments in natural-circulation boiler design. Wiener, M. (Babcock and Wilcox Co., Baberton, OH). *Proc. Am. Power Conf.;* **39**: 336-348(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design of natural circulation boilers with ribbed tubes is described. This design provides high natural circulation flow rates—even at pressures approaching the critical pressure—that maintain significant margins of safety during adverse upsets, i.e., departure nucleate boiling is avoided. With the use of ribbed tubes it is possible to meet utility requirements for natural circulation boilers of any size for 2900 psig drum operating pressure. (LCL)

56924 Design for availability: an update. Lyons, D.E.; Blackburn, S.S. (Combustion Engineering, Inc., Windsor, CT). *Proc. Am. Power Conf.;* **39**: 349-368(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The importance of designing power plant components for availability, i.e., for minimum down time due to maintenance or failures is discussed, and improvements achieved in the design, fabrication quality control, and quality assurance of major power plant components such as boilers and superheaters, coal pulverizers, pumps, and fans are discussed. (LCL)

56925 Foundations for Big Cajun No. 2. Dudek, R.A. (Bovay Engineers, Inc., Houston, TX). *Proc. Am. Power Conf.;* **39**: 508-514(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Big Cajun No. 2 is a 1080 MW coal-fired power plant under construction in Louisiana due for completion in 1980. The design of the foundations, factors which influence substructure design, and the scheduling and procedures used in constructing the foundations are discussed. (LCL)

56926 Some boiler feed equipment and system design parameters: effect on pump life. Shepherd, W.O.; Godin, R.L. (Dresser Industries, Inc., Huntington Park, CA). *Proc. Am. Power Conf.;* **39**: 515-523(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Long-term low flow operation of feedwater pumping equipment for power plants results in different kinds of cavitation damage to first-stage impellers, noisy operation, and often severe equipment vibration. Methods for avoiding these low flow problems in the design and operation of feedwater systems for new power plants and for retrofitting existing equipment are discussed. (LCL)

56927 "Ten demandments" for safe and reliable operation of steam boilers. Harrison, S.F. (National Board of Boiler and Pressure Vessel Inspectors, Columbus, OH). *Proc. Am. Power Conf.;* **39**: 719-723(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Ten rules essential for the safe and reliable operation of steam generators, mainly shop-assembled firetube and watertube boilers and small field-erected automated industrial boilers, are presented. These rules apply to the selection, installation, operation, maintenance, repair, control, and inspection of boilers. (LCL)

56928 Vibration prevention in boiler banks of industrial boilers. Rogers, J.D.; Arenstam, R.H.; Knight, R.D. (Combustion Engineering, Inc., Windsor, CT). *Proc. Am. Power Conf.;* **39**: 724-734(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Mechanical vibration of tubes and sonic vibration of the boiler bank gas column are the two types of vibrations of major concern to industrial boiler operators. Each type is different in terms of damage effects and methods used for vibration prevention. The causes, effects, characteristics and prevention of each vibration type are discussed. It is concluded that neither tube nor sonic vibrations are yet prevalent in industrial boilers. The sizes of industrial boilers, however, are increasing and experience shows that susceptibility to vibration increases with size. To avoid vibration problems in tomorrow's boilers, the research efforts of the boiler and related industries must be directed toward developing predictive and preventive techniques. (LCL)

56929 Solid-state electronic systems for power plant interlocking and control. Szczerbicki, R.C.; Iredell, D.B. (Stanley Consultants, Inc., Muscatine, IA). *Proc. Am. Power Conf.;* **39**: 755-764(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design and economics of a solid state electronic control system developed for a 350 MW coal-fired cycling power plant in the north central U.S. are discussed. (LCL)

56930 Quality assurance of General Electric industrial steam turbine-generators. Gehr, W.E. (General Electric Co., Lynn, MA). *Proc. Am. Power Conf.;* **39**: 778-783(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The quality assurance program used at the General Electric Co.'s plant for producing industrial steam turbine-generator equipment is described. (LCL)

56931 Examinations of superheater oxidation products by scanning electron microscopy. McPherson, W.G.; Martin, L.D. (Halliburton Services, Duncan, OK). *Proc. Am. Power Conf.;* **39**: 909-917(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The chemical cleaning of boiler super heat or reheat sections to remove oxidation products is becoming a common practice, and successful cleaning depends on a knowledge of the composition of the corrosion products. In an attempt to determine why certain superheat and reheat deposits behave differently in the same cleaning solvents, deposit samples were evaluated with a scanning electron microscope (SEM) and an energy dispersive x-ray (EDX) analyzer in addition to x-ray diffractometry. The procedures and results are described. The SEM and EDX analyzer proved very useful in the analysis and charcterization of corrosion products found in superheat and reheat tubes. Deposits, which have similar x-ray diffraction patterns but exhibit different dissolution properties, were studied and the information obtained through the SEM has been helpful in explaining deposit-dissolving problems. The shift in x-ray diffraction peaks was very slight with the substitution of chromium in the spinel crystal structure and routine analysis frequently identifies this deposit as magnetite. Spinels that are formed in the low chromium alloy ferritic steel reheat and superheat areas have been difficult to chemically clean. The identification of chromium in these deposits helps explain the variability that occurs in the dissolution.

56932 Feedwater line corrosion. Brown, J.; McSweeney, P. (Ontario Hydro, Toronto). *Proc. Am. Power Conf.;* **39**: 918-924(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A review of boiler tube failures throughout the US utility industry concluded that ingress of feedwater line corrosion products was the most frequent contributor to boiler tube corrosion. A project undertaken to determine the concentrations of corrosion products entering power plant steam generators and to evaluate methods for controlling boiler corrosion is described. These methods included the use of resin beds to remove Fe, Cu, Ni, and Zn and the use of chemical additives such as morpholine and hydrazine to control the dissolved oxygen concentration and pH of feedwater. (LCL)

56933 Electronic versus conventional controls in power plants: advantages and disadvantages. Zakis, E. (Sargent and Lundy, Chicago). *Proc. Am. Power Conf.;* **39**: 1226-1230(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Electronic equipment is finding increasing use for power plant equipment contol, in place of conventional relays, timers, switches, etc. The advantages and disadvantages of electronic and conventional control systems are compared to give the power plant operator an awareness of the factors which must be considered in selecting control equipment. (LCL)

56934 Some new considerations in generating-unit protection. Baldwin, M.S.; Bonk, J.J. (Westinghouse Electric Corp., Pittsburgh). *Proc. Am. Power Conf.;* **39**: 1231-1239(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The present trend in generating unit protection is to go far beyond the typical relay complement that has been used for many years. More emphasis is being placed on the monitoring of physical quantities such as vibration, temperature, mechanical torques, and incipient failure conditions than ever before. The past several years have developed an awareness of the complex machine/system interactions which are neither strictly electrical nor strictly mechanical phenomena. The effect of system operating practices on both the generator and turbine has been recognized and is being addressed by users, manufacturers, and industry technical societies. Although we do not foresee elimination of any of the standard protective relays, it is our hope that ultimately they may never be called upon to operate.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 57143

ECONOMICS

REFER ALSO TO CITATION(S) 56829, 56964, 57022

56935 (CONF-780710—4) **Guidelines for estimating nonfuel operation and maintenance costs for large steam—electric power plants.** Myers, M.L.; Fuller, L.C.; Bowers, H.I. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 22. American Association of Cost Engineers meeting; San Francisco, CA, USA (9 Jul 1978).

Nonfuel operation and maintenance costs usually are developed by escalating the current cost of existing coal and nuclear-fueled units available at the Public Information Office of the Federal Energy Regulatory Commission formerly the Federal Power Commission. Recently, operation requirements have introduced several important cost factors which are not reflected in historical data. To provide this information, estimating guidelines have been prepared and incorporated in a digital computer program first issued in 1975. A recent update of this work has been made for nuclear plants and coal plants. These procedures relate direct maintenance to labor and materials in place of plant capital investment. Costs for staff, services, and the principal miscellaneous expense components are also quantified to obtain the annual total costs. These guidelines are designed to assist in power plant evaluations for near-term projects. Specific cases are expected to require further economic assessment.

56936 **Use of cost-variance analysis to compare base-load electrical power-generation methods.** Jacobi, E.J.; Mastor, A.A. (TRW, Inc., Redondo Beach, CA). *Proc. Am. Power Conf.;* **39**: 398-406(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A simple approximate method for uncertainty analysis in electric power economics is presented. The method is called cost variance analysis and is based on probability theory. The computations can be done on a pocket calculator. The overall 30-yr levelized electric power cost for nuclear power plants is computed as an example of the procedure and the results are compared with results for coal—and oil-fired plants. (LCL)

OFF-PEAK ENERGY STORAGE

56937 **Compressed-air storage plant with a cavern in salt.** Vosburgh, K.G. (General Electric Co., Schenectady, NY); Golibersuch, D.C.; Jarvis, P.M.; Bast, J.A.; Eskesen, J.H.; Mitchell, A.S.; Sosnowicz, E.J.; Serata, S.; Pepper, J. *Proc. Am. Power Conf.;* **39**: 549-556(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A conceptual design has been completed for a compressed-air energy storage (CAES) plant sited on the McIntosh salt dome in southwestern Alabama. An overview of the design is provided, and salient results and conclusions are presented.

FUELS

REFER ALSO TO CITATION(S) 56466

56938 **Results of adoption of a 500 MW power unit pulverized fuel plant.** Mikhailov, N.M.; Osokin, V.P.; Rastyapin, V.I.; Ivannikov, V.M.; Dolbnya, Yu.A.; Stolyarevskii, V.K.; Podkorytov, I.I. *Sov. Power Eng. (Engl. Transl.);* 7: No. 3, 137-141(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 14-17(Mar 1978).

At the present time all the equipment of the Nazarov GRES fuel plant operates with sufficient reliability with indices close to the project levels. The measures which were developed and used provide explosion-safe conditions of operation and provide purification of the discharged air to the sanitary norms; the fuel losses do not exceed 0.4%. In order to improve the fuel plant characteristics it is necessary to work on improving the quality of fuel crushing to the PTE norms and on decreasing the energy consumption on pulverized fuel transport.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 56411, 56966, 56983, 57091

56939 **Fuel and power complex of the Soviet Union and its importance in the world power economy.** Vol'fberg, D.V. *Therm. Eng. (USSR) (Engl. Transl.);* **24**: No. 11, 29-32(1978).

Translated from Teploenergetika (Moscow); 24: No. 11, 66-69(1977).

The development of the fuel and electric power economies of the USSR during and since the Second World War is described. The Soviet Union contribution to the world production of commercial energy resources increased from 10.7% in 1950 to 18.5% in 1975. Topics discussed include the extraction of fossil fuels and the current level of power production capacity. (PMA)

56940 **Noise-emission characteristics of circular mechanical, natural, and fan-assist natural-draft cooling towers with silencers.** Capano, G.A. (Stone and Webster Engineering Corp., Boston). *Proc. Am. Power Conf.;* **39**: 691-701(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Inlet noise, mainly water noise, of all large, wet towers tends to average 85 to 86 dBA. Propagation of this noise, with respect to distance, is similar for all sizes of wet-style cooling towers. Outlet noise emission characteristics of circular mechanical-draft, fan-assist, and natural-draft towers show inlet-to-outlet chimney attenuation on the order of 1.5, 3.5, and 15 dB, respectively. There is a potential for outlet noise to be perceived at 3280 to 4920 ft. Berms provide effective reduction of near-field inlet noise (15 dB) for natural-draft towers, while application of mineral wool absorptive silencers to natural-draft or fan-assist inlets can provide noise attenuation of 10 to 40 dB. Silencers can be selected to control specific emission level from tower outlets as well. Lowering of fan speed for circular mechanical-draft or reducing numbers of fans on line for fan-assist towers produces noise buildup on the order of 2 dB rather than noise reduction at the inlet and outlet. When the cost is justifiable, noise reductions as much as 40 dB can readily be achieved.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 57604

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 56395, 56900

56941 (PB—276643) **Particulate control highlights: research on electrostatic precipitator technology. Final report November 1976.** Oglesby, S. Jr; Nichols, G. (Southern Research Inst., Birmingham, AL (USA)). Dec 1977. Contract EPA-68-02-2114. 23p. (SORI-EAS—77-677). NTIS PC A02/MF A01.

Highlights are given of a major EPA research program on electrostatic precipitator (ESP) technology, directed toward improving the performance of ESPs in controlling industrial particulate emissions, notably fly ash from coal combustion in electric power plants. Relationships between electrical effects, such as reverse corona, caused by high resistivity of the deposited fly ash, were investigated. The influence of fly ash particle size and chemical composition on the resistivity and dielectric strength of the deposited fly ash was also studied. Relationships were established between fly ash resistivity and chemical composition, especially its alkali metal content, for ESP operating temperatures below about 250°C. Based on these relationships, a mechanism for ionic surface conduction is proposed that complements the ionic mechanism in bulk conduction in fly ash particles at higher operating temperatures. The efficacy of conditioning fly ash by adding SO_3 to flue gas (to lower fly ash resistivity) was established in trials at electric power plants. Reentrainment of particles from deposited fly ash was also investigated in relation to ESP rapping procedures and gas flow distribution. A mathematical model of the ESP process was developed, using fundamental relationships together with measurements of ESP geometry, electrical conditions, and particle size distribution.

56942 **Modular system for reducing sulfur dioxide.** Gutterman, C.; Steiner, P. (to Foster Wheeler Energy Corp.). US Patent 4,095,953. 20 Jun 1978. Filed date 11 Apr 1977. 4p.

A system is described for reducing sulfur dioxide to elemental sulfur in which a reactor vessel is divided into a plurality of

compartments, and coal is fed from a single source into each of the compartments. A sulfur dioxide rich gas is distributed to each of the compartments and is contacted with the coal to form substantially pure sulfur.

56943 Assessment of environmental impacts of coal preparation for sulfur removal. Brudick, J.C. III.; McDowell, K.L.; Calhoun, S.H.; Krenkel, P.A. (Tennessee Valley Authority, Chattanooga). *Proc. Am. Power Conf.;* **39**: 462-466(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The SO_2 control plan being considered by TVA for its power plants is outlined, and the results of the environmental assessment of one of the projects involved in the plan, the coal-washing facility at Paradise steam plant in Kentucky, are summarized. The proposed coal-washing plant at Paradise will reduce the SO_2 emissions of the available coal supply from around 7 lb $SO_2/10^6$ Btu to below the 5.2 lb/10^6 Btu allowable emission rate. It is anticipated that the plant can be built by June 1981 at a capital cost of around $150 million (1976 dollars) and an annual cost of $32 million. However, it appears that the improved quality of the washed coal will offset current problems at the plant related to reliability, derating, and excess maintenance. These benefits are expected to offset the annual cost by as much as $16 million. Two alternative strategies for control of SO_2 emissions at Paradise were evaluated: low-sulfur coal and scrubbers. Both have operational and economic disadvantages. Based upon the analyses to date, it has been determined that a coal-washing facility at Paradise is the most cost-effective alternative for constant SO_2 emission control and that the environmental impact of this project when constructed as planned will not be significant.

56944 Fugitive dust control for power plant coal-handling and storage systems. Ege, H.D. Jr.; Ward, W.J. Jr. (Burns and McDonnell Engineers, Architects, Consultants, Kansas City, MO). *Proc. Am. Power Conf.;* **39**: 489-496(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Coal dusting mechanisms, dust sources, and some possible solutions to the control of fugitive dust in power plant coal handling and storage systems are discussed. (LCL)

56945 Optimization of waste-disposal systems in control of environmental impact of coal-fired utilities. Breitstein, L. (NUS Corp., Rockville, MD); Ellison, W.; Warner, M.; Neeley, W.M. *Proc. Am. Power Conf.;* **39**: 497-507(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The necessary future growth in the use of coal to meet U.S. energy requirements will be enhanced by the continued development and use of improved methods for controlling and disposing of waste discharges to the environment. These liquid, gaseous, solid, and thermal wastes, means for treating and controlling waste discharges, and optimal methods for minimizing the environmental impacts of waste discharges are discussed. (LCL)

56946 Operating experience with hot precipitators on Western low-sulfur coals. Walker, A.B. (Research-Cottrell, Bound Brook, NJ). *Proc. Am. Power Conf.;* **39**: 582-591(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Performance data are presented for hot precipitators operating on 29 power plants fueled with Eastern bituminous coal and for 22 plants fired with western low sulfur coal. Experience with hot precipitators on Eastern bituminous coals confirms their insensitivity to fuel ash composition, their operational reliability, and the precision with which they can be sized and configured for a desired removal efficiency. Additional operating experience with hot precipitators on Western low-sulfur coals has revealed that the fouling characteristic of the ashes from some Western coals require special consideration, just as they do in the boiler design and operation. This characteristic, in conjunction with either borderline resistivity under operating conditions prevailing, or the presence of volatile species in the ash, may require special design and/or operating techniques. These include: proper selection of electrode materials; periodic intensive cleaning of discharge electrodes; and use of chemical ash conditioning agents. It is concluded that properly designed hot precipitator systems remain a viable option for collection of particulates from boilers burning low-sulfur Western coals, and their continued use will depend on individual case analysis of their cost-effectiveness when compared with other adequately demonstrated alternatives. (LCL)

56947 Fabric-filter and electrostatic-precipitator fine-particle-emission comparison. Carr, R. (Electric Power Research Inst., Palo Alto, CA); Piulle, W.; Gooch, J.P. *Proc. Am. Power Conf.;* **39**: 595-609(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The results are presented of two projects conducted by the EPRI to evaluate the performance of electrostatic precipitators and fabric filters applied to coal-fired utility boilers. The total and fine particle removal capability of the two pollution control systems are characterized. Baghouse data shows an overall collection efficiency of 99.92% and a fine particulate collection efficiency of 99.4%. The overall efficiencies for electrostatic precipitators ranged from 99.64 to 99.9%. (LCL)

56948 Retrofit electrostatic precipitators: how do you get from here to there. Miller, R.K. (Dayton Power and Light Co., OH). *Proc. Am. Power Conf.;* **39**: 610-615(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The retrofitting of existing fossil-fuel power plants with electrostatic precipitators in order to meet recently imposed air quality standards is discussed by describing a project which consisted of installing retrofit electrostatic precipitators on Units 4 and 5 at The Dayton Power and Light Company's F.M. Tait Station. The power units placed in service in 1958 and 1959 each have a rated capacity of 130 MW. The engineering portion of the project began in mid-1972. The precipitators were placed in service on November 1975, and May 1976, respectively. The design philosophies, scheduling problems and many of the innovative concepts of breeching design and construction utilized in completing the project are described.

56949 Design problems in applying fabric collectors to boilers. Applewhite, G.D. (American Air Filter Co., Inc., Louisville, KY). *Proc. Am. Power Conf.;* **39**: 616-621(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The design, operation, cleaning, cost, and performance of fabric particle collectors, i.e., filter bags are discussed. These bags are made of woven glass fabrics. The optional designs available and the importance of each design with regard to reliability and maintainability are described. (LCL)

SITE SELECTION AND LAND USE

56950 Siting considerations for locating combustion turbine-generating units on nuclear plant sites. Connell, E. III; Tyburk, C.J. (Fluor Pioneer Inc., Chicago). *Proc. Am. Power Conf.;* **39**: 557-562(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Combined fossil/nuclear siting has been used to a limited extent in the past. Now, as regulatory constraints limit the number of new sites available for power plants, additional emphasis may be placed on combined siting of nuclear and combustion turbine units. Utilities intending to use such a combined siting arrangement will have to investigate thoroughly the safety hazards which may arise from interactions between the nuclear and combustion turbine units. The advantages to a utility of this joint siting, and those questions of safety and security that must be taken into account in the planning stages of such a project are discussed.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 56934

56951 (AD-A—049451) **Numerical results or multiconductor transmission line networks. Final report.** Baum, C.E.; Liu, T.K.; Tesche, F.M.; Chang, S.K. (Science Applications, Inc., Berkeley, CA (USA)). Nov 1977. Contract F29601-76-C-0125. 47p. NTIS PC A03/MF A01.

The algorithms and numerical results for a lossless multiconductor transmission-line network which is excited by a number of lumped voltage and current sources located on the transmission lines are described. As opposed to previous analyses of multiconductor transmission lines, the method is capable of treating networks which contain one or more closed transmission- line loops. The formulation of this analysis involves defining a large matrix equation (the BLT equation) for currents incident on each of the junctions of the transmission-line network. Matrix inversion provides the solution for these incident currents, with the reflected current component being determined from knowledge of the scattering properties of the junctions. The total junction currents are found by combining the incident and reflected components. To illustrate this approach, a single-wire network and a more general multi-conductor transmission-line network are considered with numerical results for the voltages at points within the networks displayed.

56952 Multilevel load-frequency control of interconnected power systems. Bengiamin, N.N.; Chan, W.C. (Univ. of Calgary, Alberta). *Proc. Inst. Electr. Eng. (London);* **125**: No. 6, 521-526(Jun 1978).

A two-level optimal control is presented for the load-frequency control of interconnected power systems using modern optimal control and multilevel system techniques. The controller minimizes the deviations in frequency and scheduled tie-line power resulting from sudden disturbances. The interconnected power system considered is decomposed into subsystems each of which has a first level local controller. The local controller controls each subsystem according to the interaction variables provided by a second level controller (co-ordinator). The co-ordinator improves the interaction variables to satisfy interaction feasibility by means of an iteration technique. The proposed controller is fast and simple and usually only a few iterations are required. Using the proposed controller the instability problem of subsystems is eliminated. Moreover, the proposed controller guarantees practically zero steady-state error in both frequency and tie-line power at the final time.

56953 Two-dimensional stability analyses of a circular conductor in the wake of another. Tsui, Y.T. (Hydro-Quebec Research Inst., Varennes, Quebec). *Electr. Power Syst. Res.;* **1**: No. 2, 87-95(Apr 1978).

Routh—Hurwitz stability criteria are employed to study the flutter of the leeward conductor in the wake of the fixed windward conductor within the framework of quasi-steady aerodynamic theory. Two important points of wake flutter are clarified. The symmetry principle of wake-induced flutter, in other words, the wake flutter, is symmetrical with respect to the horizontal line if there is no static coupling in the x and y directions for the suspension of the leeward conductor. When coupled, the flutter symmetry is preserved, provided the sign of the static coupling is changed. This finding is supported by recent data and is contrary to previous results. For the uncoupled case, vertical and horizontal frequency coalescence does not necessarily imply no oscillation. This is at variance with previous studies. Some highlights of the numerical results are as follows: the region of instability roughly lies between 0 < absolute value of epsilon < 0.1 and 0.8 < kappa < 1.2, where epsilon and kappa are the static coupling coefficient and frequency ratio, respectively; the region of instability enlarges as absolute value of epsilon increases from zero to 0.08 when everything else is kept fixed; for both subcritical and supercritical flow, the region of instability shrinks as d/c varies from 10 to 16, when all other factors are fixed; and the region of instability shrinks as the flow changes from subcritical to supercritical when everything else remains unchanged.

56954 Small perturbation performance of a synchronous machine using D-decomposition technique. Dyal, D.S.; O'Kelly, D. (Univ. of Bradford, Eng.). *Electr. Power Syst. Res.;* **1**: No. 2, 121-126(Apr 1978).

The D-decomposition method of analysis is used to determine the small perturbation response of a synchronous machine. Computed results are presented in the form of stability contour diagrams showing the boundaries of absolute stability or with arbitrary degrees of damping in terms of the parameters of a conventional proportional voltage regulator. The influence of the damping factor on system response is illustrated with time-domain characteristics.

56955 Infrared detection of hot spots in energized transmission and distribution equipment. Brice, C.W. III. (Texas A and M Univ., College Station). *Electr. Power Syst. Res.;* **1**: No. 2, 127-130(Apr 1978).

An important facet of transmission and substation operation is preventive maintenance of energized electrical apparatus. Problems in energized equipment often appear as hot spots due to local thermal overloads or bad electrical connections. An excellent method of locating these hot spots is remote detection of the infrared radiation emitted. This paper is a survey of infrared detection systems suitable for this application. The first part of the paper is a brief tutorial introduction to infrared detection and imaging systems. Following this introduction, a survey of commercially available systems suitable for remote detection of hot spots is presented. Finally, the highlights of new developments in infrared technology are briefly discussed and the results of the investigation are summarized.

56956 Effects of electrical faults on reliability of turbogenerator units in large steam power plants. Chiricozzi, E. (L'Aquila Univ., Italy); Spena, A. *Electr. Power Syst. Res.;* **1**: No. 2, 153-166(Apr 1978).

Because of the awareness in many countries of the objection of pollution, and the lack of available cooling water, modern steam power plants frequently lie far from load centers. Moreover, the rating of turbogenerator units is continuously growing, following technology's trends, size economies and the increasing demand on electrical energy. Power transmission lines for large distances are consequently required, thus raising the need for improved safety, reliability, and control of the power plant system as a whole. Reliability especially appears to be a critical factor, affecting the quality of delivery and the economy of production, so that improved reliability is increasingly required. The paper concentrates on the consequences of a typical electrical failure on the reliability of the largest turbogenerator unit which is going to be operated in Italy. Owing to the mutually dependent behavior of the system's different parts, obviously an interdisciplinary problem, it was necessary to construct a general model of a thermal power station which allowed for the simulation of the transient conditions under study, thus providing pertinent solution data and suggestions.

56957 Lightning direction display. Blais, R.; Belanger, J. (Hydro-Quebec Inst. of Research, Varennes, Quebec). *Electr. Power Syst. Res.;* **1**: No. 2, 167-171(Apr 1978).

For good operation of electrical energy transmission lines and safety of the line-maintenance crew it has proved very useful to be well informed about incoming electrical storms. In some isolated regions short-term meteorological information is not available; in order to compensate for this deficiency a relatively simple radio lightning direction finder, which is low in cost and occupies little space, was developed at IREQ in close collaboration with specialists from McGill University meteorological center. The results obtained suggest that this equipment will be extremely useful in remote areas of the electrical network.

56958 (DOE-tr—99) **Computer program for investigating the network protection behavior in the case of arbitary disturbances to the network.** Storch, H. (Institut fuer Energetik, Leipzig (German Democratic Republic)). Feb 1978. Translation of German report. 17p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

The present method for calculating arbitrary symmetric and asymmetric operational states in electrical energy supply networks is a universal solution algorithm which is suited to effectively solve all "asymmetry calculation" problems. An attempt was made to combine the calculation of asymmetric and symmetric operational states into a universal solution algorithm. A solution algorithm was developed for calculating parallel asymmetries and series asymmetries, and their combinations into multiple asymmetries. It is suited for calculating transient and stationary operational states. Specific features of the operational states are considered. Longitudinal, transverse, and obliquely controlled transformers can be considered as well as non-cyclical symmetric transmission lines. One can also consider inductive and capacitive influence of parallel lines, the influence of a preliminary load, and the influence of different voltages at the supply points.

56959 Load frequency control using output feedback. Venkateswarlu, K. (Regional Engineering Coll., Warangal, India); Mahalanabis, A.K. *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 200-203(Feb 1978).

From Paper meeting; Madras, India (17 Dec 1977).

The design of load frequency controllers using output feedback is discussed. The load frequency control problem of interconnected power systems is treated as an output zeroing problem, and the use of matrix minimum principle constrained controller design is presented. To overcome the computational burden involved with the exact output feedback problem, an approximate output control strategy is proposed. The effectiveness of the proposed control strategy is demonstrated by considering a 2-area system.

56960 Optimum load frequency control with restrictions on the rate of power generation. Venkateswarlu, K. (Regional Engineering Coll., Warangal, India); Mahalanabis, A.K. *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 204-207(Feb 1978).

From Paper meeting; Madras, India (17 Dec 1977).

The load frequency control problem of interconnected power systems is discussed. Magnitude restrictions on the rate of power generation are taken into account and a dual mode control strategy is proposed. The effectiveness of the proposed strategy is demonstrated through simulation studies of a 2-area interconnected power system.

56961 Power system reliability assessment through modified security indices. Nagrath, I.J.; Dasgupta, B.K. (Birla Inst. of Tech. and Science, Pilani, India). *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: 208-211(Feb 1978).

From Paper meeting; Madras, India (17 Dec 1977).

A security assessment of a composite power system is presented. Modified models for the load security and voltage security indices which take into account load shedding during contingencies are proposed from a local as well as global point of view. These require the system to be checked through repeated load flows under probable contingencies in the form of generator and line outages. To the system operators these indices would be a guide for initiating any preventive action, and to the planner these could mean a decision criterion for selecting alternative designs.

56962 Load dispatching and frequency control in interconnected network. Kaul, K.L. (Jammu and Kashmir State, Srinagar, India). *J. Inst. Eng. (India), Electr. Eng. Div.;* **58**: No. 4, vp(Feb 1978).

It is the duty of the electric undertaking to supply the system load in the most economical manner. In order to achieve the minimum operating costs with the optimum reliability for a system, the setting up of a Central Load Despatch Station is of much importance. The salient functions performed by the Load Despatch Station are discussed: (1) maintaining the frequency of the system within the tolerable limits; (2) economic production of energy from hydro pumped-storage, thermal, nuclear sources and to keep watch on the energy exchanges with the neighbouring states, so that the same is as per the agreement with them as also most economical to the system as a whole; (3) generation and maintenance scheduling and ensuring spinning reserve; (4) load forecasting; and (5) data collection and analysis.

56963 Minimization of vars in system planning. Happ, H.H.; Wirgau, K.A. (General Electric Co., Schenectady, NY). *Proc. Am. Power Conf.;* **39**: 1019-1025(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The planning of var sources is discussed. These consist of conventional fixed or switched shunt reactive devices, synchronous compensation, and variable shunt reactive control devices, which are also called Static Var Control (SVC) devices. The techniques presented give due consideration to the dynamics of the power system, and to the effects of var devices in improving system stability and thus power system security.

56964 Optimal power system operation-analysis techniques. Najaf-Zadeh, K. (Harza Engineering Co., Chicago); N'Kolas, J.T.; Anderson, S.W. *Proc. Am. Power Conf.;* **39**: 1075-1081(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A study of power system operation optimization is presented for the purpose of establishing trends in the evolution of power system operation and to begin development of the tools and techniques required for this evolution. A general technique of using linear optimization and linearization of nonlinear quantities is followed. This study concluded that: the developed techniques are applicable to real-time and on-line computer control and operation of power systems; very well developed software package can be used; generation and power flow optimization are carried out within safe margins, and will not disturb system security; this analysis is applicable to reactive power as well as real power and could be implemented in dc, ac, or a combination dc and ac transmission system; and the developed techniques could be useful for system planning and scheduling, as well as operation. (LCL)

56965 Multilevel generation control of power pools and superpools. Happ, H.H. (General Electric Co., Schenectady, NY); Koehler, J.E. *Proc. Am. Power Conf.;* **39**: 1104-1112(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

An overview is presented of the control of generation in pools and superpools, using "piecewise" methods that utilize the multicomputer configuration of the dispatch-security computers existing in pools and superpools. Experience of the NY Power Pool gained to date has also been included which summarizes the gradual shift from non-pool to full pool operation.

56966 Program for UHV transmission. Scherer, H.N. Jr. (American Electric Power Service Corp., New York); Ware, B.J.; Thoren, H.B. *Proc. Am. Power Conf.;* **39**: 1113-1120(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A brief review of power transmission lines development is followed. A research program of the American Electric Power system and the ASEA (Sweden) to test development of power transmission lines above 765 kV is described. The center near South Bend, Indiana was dedicated in October 1976. The authors conclude the program will have to give integrated attention to system overvoltages and insulation requirements; electric and magnetic fields; UHV lines; substation arrangements; transformers and reactors; surge arresters; circuit breakers; instrument transformers; and relay protection research. Iterative analyses will be required and economic trade-offs will be necessary. It is predicted that a UHV system will be developed that will offer economic and environmental benefits to the communities served. Researchers feel that voltages from 1000 kV up to 2000 kV can be introduced and sucessfully operated. (MCW)

56967 Unique computer optimization program obsoletes rule-of-thumb distribution system improvement methods. Shuford, E. (Carolina Power and Light Co., Raleigh, NC); Bryan, J. *Proc. Am. Power Conf.;* **39**: 1163-1168(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Many utilities are still using rule-of-thumb methods of regulator and capacitor replacement, even though the recent advent of the computer allows for a rigorous system analysis in a short period of time. It is the purpose of this paper to compare rule-of-thumb methods on a typical system to the same system optimized by the computer and hence determine the validity of such methods. Three rule-of-thumb methods are applied to typical systems, and the annual total cost of these replacements are compared with computer optimized systems. The computer optimized systems show significantly lower cost. (LCL)

56968 Improving protection of unit-connected generators. Gross, E.T.B. (Rensselaer Polytechnic Inst., Troy, NY). *Proc. Am. Power Conf.;* **39**: 1240-1245(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Existing methods of generator and transformer fault protection of large units are reviewed and shortcomings pointed to. Various methods are compared in a qualitative manner and improvements suggested. Included are combustion detectors for the indication of incipient faults, installed inside the tank of transformers with nitrogen cushion on top.

56969 Submarine transmission from an ocean thermal energy conversion plant. Nelson, J.A. (Gilbert/Commonwealth, Jackson, MI). *Proc. Am. Power Conf.;* **39**: 1270-1277(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

An overview is presented of some of the areas to be considered in the design and implementation of transmission cables for an Ocean Thermal Energy Conversion (OTEC) power plant. These considerations include choice of ac or dc cable system, voltage level, environmental problems, and selection of insulation. (LCL)

56970 PROBE: a feasibility demonstration of substation and distribution automation. Croghan, J.F. (Commonwealth Edison Co., Maywood, IL); Jenkins, D.R.; Rushden, F.A.; Bunch, J.B.; Gurr, G.P. *Proc. Am. Power Conf.;* **39**: 1278-1287(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Substation and distribution automation has existed for a number of years with varying degrees of sophistication. Recently trial installations have been initiated utilizing digital computer technology and advanced electronics to accomplish automation of certain substation functions. Investigations are also under way of remote meter reading and customer load management. The PROBE project is a research investigation to determine the feasibility of sampling data and creation of a data base to achieve these functions using digital techniques. A key objective of PROBE is to demonstrate the feasibility of utilizing data base information to make sophisticated decisions automatically and achieve a degree of coordination between functions not hitherto attainable. The equipment used, test procedures and results are described. Experience from the PROBE feasibility demonstration and Phase 1 tests show that the described substation and distribution automation implementation techniques are viable.

AC SYSTEMS, EHV AND UHV

56971 Evaporation-cooled transmission line system. Rabinowitz, M.; Pachot, J.J. (to Electric Power Research Inst., Inc.). US Patent 4,091,230. 23 May 1978. Filed date 9 Aug 1976. 12p.

A system is described that has one or more tubular conductors disposed within a shield containing a dielectric surrounding the conductors that is used to transmit electrical power. Liquid coolant is directed along a supply line from a source and into the conductors. Each conductor has a plurality of tubular insulators at spaced locations along its length to remove coolant vapor from within the conductor ro maintain single phase flow while at the same time operating under two-phase cooling. Another line receives the vapor and returns it to the source of liquefaction. Several embodiments of the system are disclosed.

56972 Reliable power supply tapped from the overhead ground wire on 735 kV transmission lines. Blais, R.; Berthiaume, R. (Hydro-Quebec Inst. of Research, Varennes, Quebec). *Electr. Power Syst. Res.;* **1**: No. 2, 117-119(Apr 1978).

The presence of electrical energy in the overhead ground wire on transmission lines has been known for many years. Its possible utilization in remote areas offers many advantages but unfortunately, owing to technological problems, access to this source was very difficult. Hydro-Quebec, as a utility interested in this energy source, asked its Research Institute to carry out studies of the possible applications. Very encouraging results have been

obtained. The various solutions examined with a view to making use of such available power at low cost are described together with the solution adopted for building an operational 20 kW prototype; this prototype was developed for the microwave repeaters of the James Bay project.

56973 Distribution automation using microcomputer technology. Russell, B.D. (Texas A and M Univ., College Station). *Electr. Power Syst. Res.;* **1**: No. 2, 131-137(Apr 1978).

The development of microcomputers has resulted in numerous applications in the areas of power system protection, control, and data acquisition. Micros are currently being used for communications processors in remote terminal units and in sequence of events recorders. They provide a degree of "intelligence" and flexibility previously unknown. Future applications include their use as dedicated control modules in substation automation schemes and as replacements for traditional protective relays. The combined advantages of low cost and high performance will result in widespread use in power system applications.

56974 Dynamic stability and optimal excitation control of doubly excited synchronous machine: influence of load characteristics. Subramaniam, P. (Univ. of Calgary, Canada); Berg, C.J.; Parandhama, T.K. *Electr. Power Syst. Res.;* **1**: No. 2, 139-151(Apr 1978).

This paper is concerned with the effects of connected loads on the optimal excitation control and dynamic stability of power systems, incorporating doubly excited synchronous generators. The system studied is made up of a generating unit with local load and a transmission line connecting the machine to an infinite bus. A number of operating conditions are examined, and different system parameters used in order to identify effects attributable to the regulators, tie-line reactance, and the characteristics of the local load. For purposes of comparison, corresponding results of dynamic stability studies are also presented for the system with a conventional synchronous machine.

56975 Complex study of the possibility of parallel operation of the Siberia and Kazakhstan power combines. Atamanova, G.B.; Bushuev, V.V.; Kalyughnyi, A.Kh.; Novikov, N.L. *Sov. Power Eng. (Engl. Transl.);* **7**: No. 3, 165-167(Mar 1978).

Translated from Elektr. Stn.; 7: No. 3, 39-43(Mar 1978).

The complex studies of static and dynamic stability and analysis of irregular capacity transfer showed that it is possible to connect the Siberia Power Combine to the European part of the United Power System through 500 and 220 kV transmission lines. The creation of system automatic equipment limiting the intersystem transfers of capacity will permit the transfer from Kazakhstan to the Siberia Power Combine to be maintained at up to 900 MW, and to 1200 MW during the night hours. At the calculated loads the transfer from Siberia to the Kazakhstan should be limited to 500 MW, but may be increased to 1200 MW on decrease of these loads. The criterion for the allowable transfer may be capacity through 500 kV line from the East to Novosibirsk of 900 to 1000 MW, and also the voltage level (U > or = 490 kV) at the Barnaul 500 kV substation.

56976 Turbine-generator mechanical requirements due to power system interactions. Lokay, H.E.; Raczkowski, C.; Ramey, D.G. (Westinghouse Electric Corp., Pittsburgh). *Proc. Am. Power Conf.;* **39**: 1026-1034(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The different types of faults and switching incidents in power systems cause machine/power system interactions which present the mechanical equipment designer with a bewildering array of requirements. Some of these interactions are identified and related to considerations they demand in turbogenerator mechanical design. The purpose of this is to make electrical engineers and power systems planners and operators aware of these mechanical design needs, and, conversely, to enable mechanical engineers to recognize the power system needs.

56977 Experience in maintaining and using a large on-line power-flow model. Ciesielski, E.E.; Friend, D.G.; Rooney, K.J. (Commonwealth Edison Co., Chicago). *Proc. Am. Power Conf.;* **39**: 1082-1089(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Experience gained during 4 yr of maintaining and using an on-line power flow model of the 400 bus Commonwealth Edison Co. power system in the midwest is discussed. The data acquisition and display systems used, the ability of the system to tell past, present, and predicted power flow conditions, and modifications to improve the computer are described. All in all, having a large on-line power flow model available for the past four years has proved to be an invaluable tool in the supervision of the day-by-day operation of a large bulk power transmission system. (LCL)

56978 Application of the emergency-operating-procedures analysis in generation-system reliability. Kenney, J.F. (New York Power Pool, Schenectady, NY); Moisan, R.W. *Proc. Am. Power Conf.;* **39**: 1098-1103(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The Emergency Operating Procedures (EOP) Analysis was developed as an adjunct within the traditional loss of Load Probability (LOLP) approach to evaluating generation system reliability. The EOP method has enabled the generation planner to measure generation system reliability in terms of the expected number of days that certain emergency actions must be initiated. These actions include customer appeals, voltage reductions, purchases, and disconnections. The EOP approach and its application in a study reported by the New York Power Pool are discussed. The results of this study illustrated this approach and developed the relationship for this system, between the need for emergency system actions and varying generation reliability levels as measured by loss of load probability. An approach is illustrated which can provide a meaningful interpretation of generation system reliability and can provide the basis for answering a number of significant questions now facing utility generation system planners and executives.

56979 Study of the optimum development of transmission systems with superimposed voltage levels. Magagnoli, U.; Manzoni, G.; Sforzini, M.; Taschini, A. (Centro di Ricerca Elettrica, Milan). *Proc. Am. Power Conf.;* **39**: 1121-1132(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The aim of this study is to establish general guidelines, valid for typical transmission schemes, that can be of help when planning the optimum development of electric power systems. Before starting the study of an actual system in all its complexity, such guidelines may indeed give clear indications as to the best way to follow, allowing exclusion in advance of certain alternatives, to know the relative importance of the different variables, etc., and therefore to make the study more straightforward and precise. The following are described: certain typical transmission schemes that may be representative either of a particular electric system, or of a part of it (for example, a limited geographical area); the mathematical model and digital program used for optimizing the characteristics of a transmission scheme in its evolution over a period of time; and the results obtained for the transmission schemes considered and, on the basis of these results, the definition of guidelines that may be considered generally valid for the long-term development of electric systems.

56980 Static var generators for transmission systems. Cronin, J.H. (Westinghouse Electric Corp., Pittsburgh); Lordeon, W.J.; Ostroski, G.B. *Proc. Am. Power Conf.;* **39**: 1133-1143(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

In recent years, there have been significant achievements in the field of power electronics that make it advisable to determine the potential this technology might have for use in control of reactive power during various systems operating conditions. A review is made of one scheme, the static var generator (SVG), the equipment designs that are being applied, and a discussion of some of the potential application areas, both present and future. The work to date under the EPRI program and from other studies indicates a need for fast-acting compensation equipment for application on transmission systems. The use of the SVG will offer many advantages in improved system operations as well as being an economic choice over alternative solutions. The SVG has been proven for control of flicker in arc furnace installations and makes possible the application on transmission system with assurance of high reliability and low maintenance. Each application should be studied to determine the correct rating and the ability of the SVG to provide the required improvement in system performance.

56981 Test performance and operating experience with the Navajo SSR protective equipment. Bowler, C.E.J. (General Electric Co., Schenectady, NY); Baker, D.H.; Mincer, N.A.; Vandiveer, P.R.; Rose, F. *Proc. Am. Power Conf.;* **39**: 1144-1154(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Series-compensated transmission lines can create resonance problems in the subsynchronous frequency range. This problem has been a setback for the use of series capacitors to reliably and economically operate long-distance transmission systems in close proximity with a steam turbine-generator. The static device developed and applied at the Navajo Generating Station in Arizona for protecting the generator from subsynchronous resonance is described. The device consists of four parallel LC tank circuits in series per phase and connected between the ground neutral point and the low-voltage end of each single-phase main stepup transformer high side winding. The test procedures and results are reported. The

control of subsynchronous resonance was shown to be possible by the close correspondence between test data and calculation. While stability control was verified by test directly, the transient control was not, except by the implication of the test calculation ratio for stability. The tune frequency of the filter stages has been shown sensitive to temperature. The overall stability performance with compensation and ambient temperature variation is shown to be adequate. The combination of the static filter, supplementary excitation damper control, and the SMF relay represents a coordinated package suitable for controlling subsynchronous resonance and so allows the use of series compensation for its original intended purpose. (LCL)

56982 Transient overvoltages resulting from fault initiation in series-compensated systems. Madzarevic, V. (Southern California Edison Co., Los Angeles); Rocamora, R.G. *Proc. Am. Power Conf.;* **39**: 1202-1206(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The initiation of fault on one line that results in bypassing of series capacitors on unfaulted lines can result in high overvoltages at remote locations on these lines. These overvoltages are due to the oscillatory nature of the capacitor discharge and occur prior to the fault clearing action of associated circuit breakers. These overvoltages can be reduced by critically damping the capacitor discharge circuit. They are not as likely to occur in systems that are less than 40% series conpensated.

56983 Field measurements of the electrical effects of EHV transmission lines. Fern, W.J. (Commonwealth Edison Co., Maywood, IL); Zalewski, R.A. *Proc. Am. Power Conf.;* **39**: 1207-1225(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The results of this study show the electric and magnetic fields, electrostatic induction, radio interference, and audible noise associated with a 765-kV line under actual field operating conditions. The comparison between measured and calculated data show that the electrical effects of EHV transmission lines can be predicted analytically with a reasonable degree of accuracy using existing published methods. These methods can be used by the design engineer to design EHV transmission lines to transmit needed power efficiently and economically with the minimum impact on the environment.

56984 Electrostatic induction measurements on mobile objects conducted at the Apple Grove 750 kV project. Perkins, M.D. (Westinghouse Electric Corp., Pittsburgh); Nowak, H.J. *Proc. Am. Power Conf.;* **39**: 1246-1258(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The increasing use of extra-high-voltage (EHV) transmission has required transmission line designers to consider the possible effects associated with people coming into contact with conductive objects located in the electric field of an EHV line. In early 1975 a study was undertaken to obtain field data that could be analyzed and used to predict values of induced voltages and currents from proposed 765-kV transmission lines in New York State. Specifically, the test was designed to determine the portion of calculated worst-case current a human would receive by contact with objects under realistic conditions. Voltages and currents induced into eight different objects, representing various classes of mobile objects, e.g., cars, buses, trucks, that might be present under an operating line, were measured. The experiments are described. The results are presented and compared with calculated results. The electrostatic induction tests conducted at Apple Grove showed that a person coming into contact with vehicles will generally receive less than 5% of the current induced into the vehicle, and that spark discharges from uninsulated vehicles sitting on the ground will be quite small due to leakage across the tires. (LCL)

56985 Lightning protection requirements of SF_6 substation determined by hybrid simulator. Tranen, J.D. (New England Electric System, Westborough, MA); Hedin, R.A.; Minnick, J.J.; Priest, K.W. *Proc. Am. Power Conf.;* **39**: 1288-1294(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The development of a hybrid computer simulation which can provide the type and quantity of data necessary for determining the behavior of lightning-caused surges traveling through substations is discussed. Results from a specific application on a 115-kV/345-kV station are presented. The results show that the simulation of SF_6 substations during lightning-caused surges is ideally accomplished by hybrid computer. The quantity of data for complete substation analysis may be gathered efficiently. In addition, digital graphical summaries provide quick insight into substation behavior. The application of this method to simple configurations has shown the previous assumptions must be carefully reviewed. For example, it is shown by computer simulation and analytical hand calculation that the surges with the steepest wave fronts may not produce the highest substation voltages. It is concluded that this hybrid simulation is an excellent tool in the determination of SF_6 substation response to lightning-caused surges. (LCL)

DC SYSTEMS

REFER ALSO TO CITATION(S) 56980

56986 Technical and environmental considerations in the design of the Square Butte HVDC transmission terminals. Vancers, I. (Minnesota Power and Light Co., Duluth); Molnar, A.; Fink, J. *Proc. Am. Power Conf.;* **39**: 1191-1201(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The technical and environmental considerations involved in HVDC Converter Terminal design with respect to the Square Butte HVDC Project are reported. Considerations are encountered in HVDC stations which are not generally familiar to the utility engineer involved with AC systems. Design of the transmission line is not covered.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 56881, 56882, 56919, 57072, 57073, 57074

56987 (CONF-7706130—, pp 15p, Session 5, Paper 2) **Advanced fission systems.** Dietrich, J.R. (Combustion Engineering, Inc., Windsor, CT). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

Advanced fission-power systems that satisfy current nonproliferation objectives are discussed. It is suggested that, under these constraints, the only concept for advanced systems involves energy centers with on-site reprocessing. Altered fuel cycles for reducing proliferation risks are also discussed.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 57042, 57381

56988 Control system for a boiling-water nuclear power plant. Oberle, A. (to BBC Brown Boveri and Co. Ltd.). US Patent 4,096,030. 20 Jun 1978. Priority date 22 Aug 1975, Switzerland. 4p.

A control system for a nuclear power plant which comprises a boiling-water reactor and a steam line including a control valve therein connecting the steam outlet from the reactor to a steam turbine includes a first controller of the "I-action" type responsive to the reactor pressure and a second controller of either the "P-action" or "PD-action" type responsive to the pressure in the steam line immediately in advance of the control valve. A summing device is provided for adding the output signals from the two controllers, and the output from the summing device is applied to the control valve for regulating its operation. For a system wherein a pair of steam lines each including a control valve therein are connected in parallel from the reactor steam outlet to the turbine, transducers are provided for measuring the respective pressures in the steam lines and a second summing device is connected to the outputs from the transducers for determining the mean value of the respective pressures in the steam lines. The output of the second summing device is then connected to the input of the second controller.

56989 Design and planning for effective in-service inspection. Breynaert, J.A.; Dennis, J.R. Jr. (Stone and Webster Engineering Corp., Boston). *Proc. Am. Power Conf.;* **39**: 241-250(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

General requirements and guidelines for BWR and PWR in-service inspection programs are presented.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 56989, 57040, 57042

56990 Modular in-core flow filters for a nuclear reactor. Mayers, J.B.; Desmarchais, W.E.; Shallenberger, J.M. (to Westinghouse Electric Corp.). US Patent 4,096,032. 20 Jun 1978. Filed date 19 Aug 1976. 6p.

A modular in-core flow filter for capturing potentially harmful debris during cold hydrostatic and hot functional testing of a nuclear reactor is described. Since testing is carried out before fuel assemblies are placed in the reactor, multiple filters, each being of the same size and configuration, are temporarily installed on the reactor lower core plate. They fill the space which later is occupied by fuel assemblies when the assemblies are installed in an operating position. Each filter includes a square metal base having a single axial opening which desirably covers four holes in the core plate. Fine mesh and coarse mesh screens are secured in the axial opening and the unit is removably attached to the core plate by brackets which extend through the metal base and engage the underside of the core plate but are actuated into position from the upper side of the core plate. When functional flow testing of the primary coolant system has been completed, the filters are removed for subsequent use in other reactors. Any debris caught by the screens and in the bottom of the pressure vessel is removed and the fuel assemblies are then loaded into the reactor. 6 claims, 4 figures.

56991 Holddown structure for a nuclear reactor core. Anthony, A.J. (to Combustion Engineering, Inc.). US Patent 4,096,034. 20 Jun 1978. Filed date 16 Dec 1976. 8p.

The core support barrel and upper guide structure of a nuclear reactor are hung from the upper internal ledge of the reactor vessel and clamped to the ledge with spring structure actuated from the vessel closure.

56992 Pressurized-water reactor installation. Greischel, C.; Harand, E.; Maritsch, F.; Maritsch, F.; Michel, E. (to Siemens AG). US Patent 4,094,737. 13 Jun 1978. Priority date 30 Apr 1977, German, Federal Republic of (F.R. Germany). 6p.

A pressurized-water coolant reactor installation includes a reactor pressure vessel, a steam generator containing a heat exchanger through which coolant from the vessel is circulated, and a single pipe interconnecting the vessel and generator and internally divided into two conduits for conducting the coolant to the steam generator and from the latter back to the vessel. This single pipe is divided into these two conduits by a partition wall extending longitudinally for the length of the pipe inside of the pipe. This horizontal partition is formed by at least two sections extending radially from the inside of the coolant pipe towards each other and having inner edges spaced from each other and interconnected by an expansion joint.

56993 EPRI steam generator programs. Martel, L.J. (Electric Power Research Inst., Palo Alto, CA); Passell, T.O.; Bryant, P.E.C.; Rentler, R.M. *Proc. Am. Power Conf.;* **39**: 825-839(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The paper describes the current overall EPRI steam generator program plan and some of the ongoing projects. Because of the recent occurrence of a corrosion phenomenon called "denting," which has affected a number of operating utilities, an expanded program plan is being developed which addresses the broad and urgent needs required to achieve improved steam generator reliability. The goal of improved steam generator reliability will require advances in various technologies and also a management philosophy that encourages conscientious efforts to apply the improved technologies to the design, procurement, and operation of plant systems and components that affect the full life reliability of steam generators.

56994 PWR secondary water chemistry study: progress report. Pearl, W.L.; Sawochka, S.G. (Nuclear Water and Waste Technology Corp., San Jose, CA). *Proc. Am. Power Conf.;* **39**: 840-848(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

In February 1975, the Electric Power Research Institute (EPRI) initiated a program with Nuclear Water and Waste Technology Corporation (NWT) to carry out a "PWR Secondary Water Chemistry Study." Five plants were selected for study to achieve the program's technical objectives. Their pertinent design characteristics are summarized. A brief description of each plant is given.

56995 Solids behavior in once-through nuclear steam systems. Bell, M.J. (Babcock and Wilcox Co., Lynchburg, VA); Mravich, N.J.; Pocock, F.J.; Rubright, M.M. *Proc. Am. Power Conf.;* **39**: 849-865(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

This paper discusses research work directed toward determining the distribution of solid contaminants in nuclear once-through systems. A review of current operating chemistry results is provided for several plants, along with the results of turbine deposit examinations. In one condensate polished plant, the distribution of solids is described in detail through the cycle. These data are of current interest because they show the concentrations of contaminants not normally measured by operators due to limitations in direct analysis methods. Also included in this research paper are basic data on solubility of sodium hydroxide and sodium chloride in superheated steam.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 56620, 57037, 57191, 57250

56996 (TREE—1116, pp 197-211) **Reactor experiment design studies.** Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Progress in reactor design studies is reported. The studies included GRIST conceptual design physics calculations for an instrumented fuel assembly in the Halden HBWR, and reactor physics studies for an advanced HTGR experiment in the ETR.

56997 Block fuel element for gas-cooled high temperature reactors. Hrovat, M.F. (to Nukem GmbH). US Patent 4,092,384. 30 May 1978. Filed date 26 Feb 1975. 8p.

The invention concerns a block fuel element consisting of only one carbon matrix which is almost isotropic of high crystallinity into which the coated particles are incorporated by a pressing process. This block element is produced under isostatic pressure from graphite matrix powder and coated particles in a rubber die and is subsequently subjected to heat treatment. The main component of the graphite matrix powder consists of natural graphite powder to which artificial graphite powder and a small amount of a phenol resin binding agent are added.

56998 Fuel elements for nuclear reactors and method for testing the circulation of fuel elements in a core of a nuclear reactor. Schweiger, F.; Fritzsche, W. (to Hochtemperatur-Kernkraftwerk GmbH (HKG) Gemeinsames Europaisches Unternehman). US Patent 4,092,217. 30 May 1978. Priority date 30 Mar 1973, German, Federal Republic of (F.R. Germany). 8p.

A method of testing the circulation of a bulk charge of fuel elements in the core of a pebble bed type of nuclear reactor comprises increasing the electrical conductivity of a number of fuel elements and then injecting the marked elements into a bulk charge of other unmarked elements having a lower electrical conductivity at predetermined positions in the core of a nuclear reactor and at measured times. The marked fuel elements are subsequently detected electromagnetically as they are carried in the bulk charge of unmarked elements through an electromagnetic field generated by a detection and measurement station. The elements are marked by including a material having a greater electrical conductivity than the remainder of the element and this material may be coated on the surface of the elements or incorporated in the body of the elements.

56999 Fuel element for high temperature reactors. Huschka, H.; Herrmann, F.J. US Patent 4,092,218. 30 May 1978. Priority date 25 Feb 1972, German, Federal Republic of (F.R. Germany). 6p.

A fuel element for high temperature reactors with good heat transfer from the fuel charge to the structural graphite is obtained by seating the fuel charges without a gap in the bores of the structural graphite. 31 claims, 2 figures.

57000 Design and development of the gas turbine HTGR power plant. Schoene, T.W.; Krase, J.M. (General Atomic Co., San Diego, CA). *Proc. Am. Power Conf.;* **39**: 538-548(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The technical features and performance of commercial-type GT-HTGRs have been established by conceptual design studies and R and D. Economic and technical assessments of the GT-HTGR indicate very substantial economic incentives and no major technical feasibility problems. International cooperation in a development and nuclear demonstration plant program offers an attractive means for establishing the necessary basis for eventual commercial utilization of the GT-HTGR.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 57029, 57035, 57044, 57107, 57185, 57186, 57310

57001 (ANL—78-30) **Tritium meters for use in LMFBR sodium coolant.** Skladzien, S.B.; Renner, T.A.; Raue, D.J.; McPheeters, C.C. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 21p. AT.

Tritium meters for continuously measuring tritium concentrations in the liquid metal coolant of fast breeder reactors have been designed, built, and tested. The tritium meters operate by diffusion of tritium from the sodium through a nickel membrane into a sweep-gas stream. The sweep gas flows to a gas-proportional-counting tube in which the tritium activity is measured. Tests on the Apparatus for Monitoring and Purifying sodium (AMPS) at ANL have shown excellent agreement between calculated and observed count rates under various conditions of sweep-gas flow rate and membrane temperature.

57002 (CONF-780401—11) **Assessment of nuclear data files via benchmark calculations: a report on the NEACRP/IAEA international comparison calculation of a large LMFBR.** LeSage, L.G.; Wade, D.C.; McKnight, R.D.; Freese, K.E. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 19p. Dep. NTIS, MF A01.

From Topical meeting on advances in reactor physics; Gatlinburg, TN, USA (9 Apr 1978).

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The results of an international comparison calculation of a large (1250 MWe) LMFBR benchmark model are presented and discussed. Eight reactor configurations were calculated. Parameters included with the comparison were: eigenvalue, k/sub infinity/, neutron balance data, breeding reaction rate ratios, reactivity worths, central control rod worth, regional sodium void reactivity, core Doppler and effective delayed neutron fraction. Ten countries participated in the comparison, and fourteen solutions were contributed. The discussion focuses on the variation in parameter values, the degree of consistency among the various parameters and solutions, and the identification of unexpected results. The results are displayed and discussed both by individual participant and by groupings of participants (e.g., results from adjusted data sets versus non-adjusted data sets). Unexpected large variations among results were observed for radial reaction rate and worth distributions and for the central control rod worth.

57003 (CONF-7706130—, pp 12p, Session 2, Paper 1) **Future of the breeder in the U.S.** Iacobellis, S.F. (Atomics International Div., Canoga Park, CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The current political and social forces affecting the U.S. LMFBR program are discussed. The need for timely LMFBR development is emphasized.

57004 (CONF-7706130—, pp 17p, Session 2, Paper 2) **LMFBRs: where do we go from here.** Beckjord, E.S. (Energy Research and Development Administration, Washington, DC). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The mission and current status of the U.S. LMFBR program are discussed. Changes in the program made by the Carter administration are described, and the direction and pace of future activities are discussed.

57005 (CONF-7706130—, pp 9p, Session 2, Paper 3) **Outlook for gas-cooled fast reactors.** Rickard, C.L. (General Atomic Co., San Diego, CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

Reasons supporting an encouraging outlook for the development and deployment of GCFR-type reactors are discussed. These reasons include fuel-cycle flexibility, relationship to previously-developed HTGR technology, safety features, capital costs, and others.

57006 (CONF-7706130—, pp 32p, Session 2, Paper 4) **Potential for the molten-salt breeder reactor.** Reichle, L.F.C. (Ebasco Services Inc., New York). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

Some possible advantages of MSBR's relative to LMFBR's are discussed. These advantages relate to cost, safty, environmental effects, and proliferation problems.

57007 (GEFR—00320(vol.2)) **Clinch River reload core design study. Volume II: recommended core design evaluation.** Deane, N.A. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Feb 1978. Contract EY-76-C-03-0893-031. 334p. $12.00.

Information on the Clinch River Breeder Reactor reload core design is presented concerning neutronic performance evaluations, recommended core thermal-hydraulic performane, mechanical performance, CRBR constraints, and economic impact of the recommended core designs.

57008 (GEFR—10028-66) **Core engineering. Sixty-sixth quarterly report, February 1978—April 1978.** (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). May 1978. Contract EY-76-C-03-0893-031. 30p. AT.

Information is presented concerning the fabrication of grid spacers and test assemblies, and classification of core components.

57009 (HEDL-SA—1469) **Fatigue-crack propagation analysis of LMFBR piping.** James, L.A. (Westinghouse Hanford Co., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 15p. (CONF-780609—11). Dep. NTIS, PC A02/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

The techniques of linear-elastic fracture mechanics were employed to estimate the in-service extension of hypothetical flaws in two LMFBR primary piping elbows. The paper describes the technical basis for the conclusion that very little crack growth will occur in these components due to either the anticipated normal, upset, and emergency events, as well as some unlikely "abnormal" events. The two examples treated include a hot leg elbow and a cold leg elbow. The assumptions and approximations concerning stress and loading conditions, the expected in-service operational environment, and material property behavior are discussed in detail. Based upon the analyses, it is concluded that significant crack extension is very unlikely under these LMFBR primary piping conditions.

57010 (HEDL-TME—78-1) **Large heterogeneous reference fuel design study. Final report.** Chandler, J.C.; Marr, D.R.; McCurry, D.C.; Cantley, D.A.; Omberg, R.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1978. Contract EY-76-C-14-2170. 121p. Dep. NTIS, PC A06/MF A01.

The fuel pin geometry used in the Fast Test Reactor (FTR) and considered for use in a prototypic small breeder installation has been evaluated through a comprehensive development program during recent years so that an extensive data base exists for extrapolation of the FTR fuel pin and geometry to larger installations. The objectives of the Large Heterogeneous Reference Fuel Design Study (LHRFDS) were to evaluate the performance capabilities of the reference FTR fuel pin in a 1200 MWe reactor plant installation and to identify a corresponding optimum core design. For purposes of the study, a reference fuel assembly was defined, corresponding to the FTR fuel pin with axial blankets placed in a 217-pin assembly. The reference assembly was used to define a reference core, which approximated FTR technology extrapolated to prototypic small breeder conditions. Performance indices of the reference core were provided by ARD during the study.

57011 (WAPD-TM—1304) **Model to predict swelling, gas release, and densification in oxide fuels (AWBA development program).** Dollins, C.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1978. Contract EY-76-C-11-0014. 45p. Dep. NTIS, PC A03/MF A01.

A model was developed to predict in-pile fission gas swelling, gas release, and densification in oxide fuels. This model considers fission gas behavior at the grain interior, on the grain boundaries, and at grain boundary edges under conditions of total gas bubble destruction by fission fragments and partial gas bubble destruction. When gas bubble swelling on grain edges reaches 5 percent, it is assumed that gas tunnels form along the edges. Gas release takes place by migration of the gas in the grains and on the grain boundaries to the edge tunnels. Intergranular and intragranular densifications are considered. Densification takes place by vacancy boil-off due to thermal excitation and vacancy knockout by the passage of fission fragments through the pores. The migration rates of both vacancies and interstitials to pores are also calculated. Comparisons are made between the model and experimental data for swelling, gas release, and densification and found to be in reasonable agreement in most cases.

57012 (BNWL-tr—335) **Behavior of standard Rapsodie Fortissimo fuel at high burnup.** Blanchard, P.; Lambert, G.; Millet, P.; Mikailoff, H. (International Atomic Energy Agency, Vienna (Austria)). Jul 1978. Translation of IAEA-SM—225/8. (CONF-780407—7). 21p. Dep. NTIS (US Sales Only), PC A02/MF A01.

From Symposium on design, construction and operating experience of demonstration liquid metal fast breeder reactors; Bologna, Italy (10 Apr 1978).

Results are presented which were obtained by destructive examination of a complete fuel bundle of 61 rods with 10 at. % burnup from the Rapsodie Fortissimo reactor. A set of micrographic sections was cut through the bundle at linear power levels of 290 to 400 W/cm. The temperature distributions evaluated at a given height, starting from the positions at the limit of the zones containing columnar grains, are remarkably similar from rod to rod (mean deviation ca. 25°C), whereas the central-hole diameters are strongly disperse. These dispersions are clearly greater than expected from the range of data on fuel fabrication. It is shown that they are due to several factors: random radial distribution of the clearance in the fissures, variable swelling of the steel of the cans and variable in-pile sintering of the oxide. In-pile sintering of pellets and swelling of cans lead to overheating of the oxide surface and to continuous evolution of the structures. However, the central temperatures continue to be low, and below their value at the start of the service life.

57013 Nuclear reactor refueling system. Wade, E.E. (to Westinghouse Electric Corp.). US Patent 4,096,031. 20 Jun 1978. Filed date 22 Jul 1976. 10p.

A system for transferring fuel assemblies between a nuclear reactor core and a fuel storage area while the fuel assemblies remain completely submerged in a continuous body of coolant is described. The system comprises an in-vessel fuel transfer machine located inside the reactor vessel and an ex-vessel fuel transfer machine located in a fuel storage tank. The in-vessel fuel transfer machine comprises two independently rotatable frames with a pivotable fuel transfer apparatus disposed on the lower rotatable frame. The ex-vessel fuel transfer machine comprises one frame with a pivotable fuel transfer apparatus disposed thereon. The pivotable apparatuses are capable of being aligned with each other to transfer a fuel assembly between the reactor vessel and fuel storage tank while the fuel assembly remains completely submerged in a continuous body of coolant. 9 claims, 7 figures.

57014 Method of bringing nuclear power plant to fractional electrical load conditions. Iljunin, V.G.; Kuznetsoy, I.A.; Murogov, V.M.; Shmelev, A.N. US Patent 4,093,514. 6 Jun 1978. Filed date 22 Feb 1977. 8p.

A method is described of bringing a nuclear power plant to fractional electric load conditions, which power plant comprises at least two nuclear reactors, at least one nuclear reactor being a breeder and both reactors transferring heat to the turbine working substance, consisting in that the consumption of the turbine working substance is reduced in accordance with a predetermined fractional load. At the same time, the amount of heat being transferred from the nuclear reactors to the turbine working substance is reduced, for which purpose the reactors are included in autonomous cooling circuits to successively transfer heat to the turbine working substance. The breeding reactor is included in the cooling circuit with a lower coolant temperature, the temperature of the coolant at the inlet and outlet of the breeder being reduced to a level ensuring the operation of the nuclear power plant in predetermined fractional load conditions, due to which the power of the breeder is increased, and afterheat is removed.

57015 Horizontal baffle for nuclear reactors. Rylatt, J.A. (to Dept. of Energy). US Patent 4,080,255. 21 Mar 1978. Filed date 31 Aug 1976. vp.

PAT-APPL-719,318.

A horizontal baffle disposed in the annulus defined between the core barrel and the thermal liner of a nuclear reactor thereby physically separating the outlet region of the core from the annular area below the horizontal baffle is described. The horizontal baffle prevents hot coolant that has passed through the reactor core from thermally damaging apparatus located in the annulus below the horizontal baffle by utilizing the thermally induced bowing of the horizontal baffle to enhance sealing while accommodating lateral motion of the baffle base plate.

57016 Method of locating a leaking fuel element in a fast breeder power reactor. Honekamp, J.R.; Fryer, R.M. (to Dept. of Energy). US Patent 4,080,250. 21 Mar 1978. Filed date 20 Nov 1973. 8p.

PAT-APPL-417,652.

Leaking fuel elements in a fast reactor are identified by measuring the ratio of ^{134}Xe to ^{133}Xe in the reactor cover gas following detection of a fuel element leak, this ratio being indicative of the power and burnup of the failed fuel element. This procedure can be used to identify leaking fuel elements in a power breeder reactor while continuing operation of the reactor since the ratio measured is that of the gases stored in the plenum of the failed fuel element. Thus, use of a cleanup system for the cover gas makes it possible to identify sequentially a multiplicity of leaking fuel elements without shutting the reactor down.

57017 Plug-to-plug gas transfer system. Poindexter, A.M. (to Dept. of Energy). US Patent 4,080,254. 21 Mar 1978. Filed date 28 Apr 1978. 8p.

PAT-APPL-680,826.

A system is described for conducting a fluid from one component to another component of a nuclear reactor wherein at least one such component is a rotatable closure head plug capable of movement relative to the other component. The conducting system utilizes the annulus located between the components as a connecting passageway for the fluid.

57018 Core disruptive accident margin seal. Garin, J. (to Dept. of Energy). US Patent 4,078,969. 14 Mar 1978. Filed date 13 Aug 1976. 10p.

PAT-APPL-714,221.

An apparatus is described for sealing the annulus defined between a substantially cylindrical rotatable first riser assembly and plug combination disposed in a substantially cylindrical second riser assembly and plug combination of a nuclear reactor system. The apparatus comprises a flexible metal member having a first side attached to one of the riser components and a second side extending toward the other riser component and an actuating mechanism attached to the flexible metal member while extending to an accessible location. When the actuating mechanism is not activated, the flexible metal member does not contact the other riser component thus allowing the free rotation of the riser assembly and plug combination. When desired, the actuating mechanism causes the second side of the flexible metal member to contact the other riser component thereby sealing the annulus between the components.

57019 Heat rejection for the Clinch River Breeder Reactor Plant. Donaldson, A.M. (Burns and Roe, Inc., Los Angeles). *Proc. Am. Power Conf.;* **39**: 702-708(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

This paper details the optimization and selection of the following cooling systems: mechanical-draft wet tower, mechanical-draft wet/dry tower, hyperbolic or natural-draft tower, and a spray pond.

REGULATION AND LICENSING

57020 Future NRC inspections or operating reactors. Volgenau, E. (Nuclear Regulatory Commission, Washington, DC). *Proc. Am. Power Conf.;* **39**: 251-254(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Information on the NRC inspection of nuclear power plants is presented concerning the locating of NRC inspectors near or at the reactor sites, direct measurement and observation by the NRC, and licensee incentives.

ECONOMICS

REFER ALSO TO CITATION(S) 56935, 56936

CONSTRUCTION AND OPERATION

57021 Economics of high-back-pressure turbines with dry cooling systems. Mitchell, R.D.; Rossie, J.P. (R.W. Beck and Associates, Denver). *Proc. Am. Power Conf.;* **39**: 300-308(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Comparative economic analyses for dry-cooled 1000 MW(e) nuclear power plants using three different turbine-generator designs were performed. The analyses indicated that, if nuclear fuel costs continue to increase, a modified conventional unit with exhaust pressures up to 8 in. Hg absolute would be more economical than a high-back-pressure unit (15 in. Hg absolute). Since the modified conventional unit might also be feasible for evaporative and wet/dry cooling, a utility could place an order for the turbine-generator before reaching a final decision on the type of cooling system to be used. (HDR)

57022 Study of feedwater cycles with multiple direct-contact heaters. Oliker, I. (Burns and Roe, Inc., Oradell, NJ). *Proc. Am. Power Conf.;* **39**: 476-486(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Existing experimental data from the testing of feedwater cycles using direct-contact heaters (DCH) are reviewed, and practical aspects of how the DCH units can be incorporated into existing and new power stations are examined. It is concluded that the small gain in turbine cycle efficiency with DCH units must be carefully evaluated against the possibility of turbine-generator damage due to water induction. (HDR)

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 57866

57023 (TREE—1116, pp 167-196) **Model and code development.** Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Progress in model and code development for reactor physics calculations is summarized. The codes included CINDER-10, PHROG, RAFFLE GAPP, DCFMR, RELAP/4, PARET, and KENO. Kinetics models for the PBF were developed.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 56896, 57214, 57483

57024 **Core for a nuclear reactor.** Barry, R.F. (to Westinghouse Electric Corp.). US Patent 4,096,033. 20 Jun 1978. Filed date 20 Jun 1975. 6p.

A reactor core having tandem arranged fuel regions for use in a water moderated nuclear reactor is described. An upper core region is fueled with enriched uranium oxide; while, a lower core region is fueled with a plutonium oxide. An intermediate core region contains natural uranium oxide.

57025 **Nuclear fuel storage rack.** Soot, O. US Patent 4,088,897. 9 May 1978. Filed date 19 Jan 1977. 8p.

A nuclear fuel storage rack comprising a rigid honeycomb formed of checkerboard-arrayed, corner-joined elongated tubular enclosures is described. Each enclosure comprises a structural wall section containing embedded poison material. Additional poison filled tubes may be located in the spaces formed between the connected enclosures.

FUEL ELEMENTS

57026 (HEDL-SA—1309) **Helium production measurements for neutron dosimetry and damage correlations.** Farrar, H. IV; Lippincott, E.P. (Atomics International Div., Canoga Park, CA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 15p. (CONF-771036—16). Dep. NTIS, PC A02/MF A01.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

Helium accumulation fluence monitors (HAFM's), consisting of miniature vanadium capsules containing small, accurately-known amounts of ^{10}B or ^{6}Li, are being used routinely for neutron dosimetry measurements in breeder reactor environments. Additionally, solid wires of Al, Fe and Cu have been irradiated by 14.8-MeV neutrons from the d-T reaction, and measurements of the helium production along these wires have given detailed neutron fluence profiles. Additional materials with relatively high (n,α) cross sections are being tested in a wide variety of neutron environments to select HAFM sets that will provide spectral information by unfolding techniques. The mass spectrometric helium measurement technique has been demonstrated to produce results with better than 2% (1 sigma) absolute accuracy. Intercomparisons with other laboratories have demonstrated good correlations with radiometric and fission chamber dosimetry results.

57027 (HEDL-SA—1461) **Effects of irradiation temperature, fluence, and heating rate on flow properties of cladding under simulated temperature transient heating and deformation conditions.** Cannon, N.S.; Duncan, D.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1978. Contract EY-76-C-14-2170. 20p. (CONF-780722—4). Dep. NTIS, PC A02/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

Irradiation temperature, fluence, and heating rate effects on plastic flow and failure properties of fast reactor cladding were investigated by heating internally pressurized specimens until failure occurred. Specimens tested were from 20% cold-worked Type 316 stainless steel cladding, irradiated in the Experimental Breeder Reactor-II at temperatures to 720°C and fluences to 10^{23} n/cm^2 ($E > 0.1$ MeV). A monotonic decrease of transient failure temperature with increasing irradiation temperature was observed at the "standard" heating rate of 5.6°C/s. This effect became more pronounced for irradiation temperatures above 600°C. Transient failure temperatures generally decreased with increasing fluence for tests performed at the standard heating rate. Irradiated and unirradiated specimens were tested at several heating rates. For equal stress, fluence, and irradiation temperature, decreasing the heating rate decreased failure temperatures by as much as 170°C for irradiated specimens and 150°C for unirradiated specimens. Data reported fall well within FFTF design limits for transient conditions and serve to confirm the material properties currently used in the design analyses.

57028 **Casing for the fuel elements of a water-cooled nuclear reactor.** Andrieu, J.L.; Delafosse, J. (to Commissariat a l'Energie Atomique). US Patent 4,088,534. 9 May 1978. Priority date 4 Jun 1975, France. 8p.

The casing is made up of a number of identical compartments of prismatic shape in which are placed vertically either one or a number of fuel element bundles which are not secured to the casing, the casing walls being provided with means for guiding control rods, supplying emergency coolant and positioning measuring devices. At least some of the casing walls are constituted by two parallel thin metal sheets welded at intervals to stiffening webs which extend between the two metal sheets to the full height of the casing and parallel to the axis of the reactor. 3 claims, 10 figures.

CONTROL SYSTEMS

REFER ALSO TO CITATION(S) 56922

57029 **Monitoring device for nuclear reactor control rods.** Blanc, R.; Jacquelin, R. (to Commissariat a l'Energie Atomique). US Patent 4,094,369. 13 Jun 1978. Priority date 8 Oct 1974, France. 8p.

Weighing of each control rod and at least the moving portion of the control rod drive mechanism is carried out in continuous operation by means of an assembly comprising at least one strain gage mounted in a circuit for measuring the electrical resistance of the gage according to the change in length which is a function of the weight being measured.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 56661, 57578

SITING

REFER ALSO TO CITATION(S) 56950

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 57023, 57035, 57038, 57039, 57041

57030 (TREE—1116, pp 163-165) **Transient reactivity meter.** Yarbrough, W.M. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A prototype of a transient reactivity meter (TRM) has been constructed and successfully tested at the ATR critical facility. This TRM is a combination hard-wired/programmable analog computer that performs a closed-loop inverse solution of the space-independent reactor kinetics differential equations. It has several features, compared with those of other reactivity-measuring devices, that provide distinct advantages in performing reactivity measurements: (1) It is a closed-loop solution (which is inherently stable) wherein the solution rho is "forced" at the output of a high-gain network. (2) The solution for rho is performed entirely within the negative feedback loop, thus minimizing the required number of calculational stages and components. (3) It will recover when reset (to the initial-condition mode) during maneuvering (slow) positive transients, thus accommodating input range-switching during such transients. (4) It is programmable to the extent that delay-group parameters, input and output ranges, and tau$_0$ (or l/β/sub eff/) can be readily changed and/or readjusted to provide for its use with different reactors or to compensate for aging of electrical components. (5) It has a built-in test function, which provides for rapid checkout in the field.

57031 (TREE—1116, pp 231-232) **Criticality evaluation of LOFT fuel removal and insertion cask (FMIRC).** Lofthouse, J.H.; Fast, E. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

The LOFT Fuel Module Insertion and Removal Cask (FMIRC) is designed for handling LOFT fuel modules at both the reactor and in the TAN storage canal. The cask design must prevent criticality in the borated water environment of the LOFT reactor vessel and in the unborated water in the storage canal. A criticality evaluation has been performed to determine if the design is adequate to prevent criticality under the expected conditions of operation. First, parametric analyses were performed on the fuel module to determine the most reactive condition. The studies considered missing fuel pins, bowed pins, and perforated pins where water has leaked inside the cladding. These calculations, using a detailed model of the fuel module in the Monte Carlo computer code KENO, showed that deforming the module has only a small effect on the calculated k-effective of the water moderated and reflected module. Next, calculations were performed with a full LOFT module in the FMIRC moderated with room-temperature water. This model included the stainless steel cask liner designed to center and hold the module inside the cask. The results of the analysis shown in Table I demonstrate that the cask design is adequate. The analysis also shows that two LOFT fuel modules placed in close proximity to each other in cold water may not be a safe configuration.

57032 (TREE—1116, pp 237-263) **Test reactors.** Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Progress in studies concerning or using the ATR or the ETR are described.

57033 (TREE—1116, pp 265-290) **Power Burst Facility.** Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Physics calculations for several experiments in the PBF Reactor are summarized.

PROPULSION REACTORS

REFER ALSO TO CITATION(S) 57073

57034 (TREE—1116, pp 233) **Criticality evaluation for the UFSF Rover rack .** Jones, R.R.; Shaffer, C.J. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A nuclear criticality safety evaluation was performed on the Unirradiated Fuel Storage Facility (UFSF) Rover rack to demonstrate subcriticality of the loaded rack for all degrees of moderation using Hanford boron splines to reduce the reactivity. The KENO II, Version 5, criticality code with 16-group Hansen and Roach cross sections was used for the calculations. The fully loaded Rover rack was found to be subcritical for all degrees of moderation with large conservatisms included in the model. The calculated maximum k-effectives with optimum moderator for both the most reactive reflector condition and for a reflector condition more representative of the actual reflector (but still conservative) are 0.994 and 0.972. This analysis of the Rover rack moderated to the most reactive conditions shows a very small safety margin. However, optimum moderation of the entire rack is an inconceivable event as multiple failures of both physical and administrative controls must occur in order to introduce the concentrations of water required to approach an optimumly moderated condition.

REACTOR SAFETY

57035 (ANL-RDP—68) **Reactor Development Program progress report, February 1978.** (Argonne National Lab., IL (USA)). 7 Apr 1978. Contract W-31-109-ENG-38. 173p. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. II (EBR-II), Breeder-reactor Design Support, Instrumentation and Control, Reactor Physics, Reactor Safety, and Other Fast Breeder Reactors.

57036 (CENPD—141(Rev.2)) **DDIFF-1 Code: a description of the DDIFF-1 digital computer code for reactor plant subcompartment analysis. Plant engineering.** (Combustion Engineering, Inc., Windsor, CT (USA)). Mar 1978. 161p. Combustion Engineering, Inc., Windsor, CT.

This report provides a description of the DDIFF-1 digital computer program. This code calculates the transient response of the reactor plant subcompartments in the unlikely event of a loss-of-fluid incident in a high energy fluid system. The DDIFF-1 computer program is primarily used to predict subcompartment conditions for the first few seconds following incident initiation during which the maximum pressure differentials on structures or components would occur. The transient calculations include determination of mass flow rates, mass and energy inventories, absolute and differential pressures, and temperatures in the subcompartment system. The subcompartment system is a control volume-flow path spatial network created based upon the geometry of the plant regions being analyzed. Blowdown mass and energy release rates from the postulated fluid system rupture are determined by an independent computer program and these histories are input to DDIFF-1.

57037 (GA-A—15000) **HTGR accident initiation and progression analysis status report. Phase II risk assessment.** (General Atomic Co., San Diego, CA (USA)). Apr 1978. Contract EY-76-C-03-0167-065. 694p. Dep. NTIS, PC A99/MF A01.

The primary purpose of this report is to document AIPA studies performed on the HTGR since issuance of the eight volumes. Implementation of the R and D recommendations is discussed, which includes consideration of new initiating events and accident sequences, modeling of fission product release from fuel particles, factors affecting PCRV plateout during core heatup, and the effect of earthquakes on plant operation. The Phase II risk assessment of core heatup events is presented. The major elements of the study include event trees and probability assessments, physical process evaluations, and evaluation of fission product transport and the associated radiological consequences. A risk assessment of accidents initiated by failures of the steam generators, including economizer-evaporator-superheater sections and the reheaters, is presented and the impact of various plant design options is quantified.

57038 (LTR—111-88(Rev.D)) **Zero-power physics testing safety analysis.** Dimenna, R.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 16 Jun 1978. Contract EY-76-C-07-1570. 105p. Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

The LOFT Final Safety Analysis Report has been reviewed to determine the adequacy of the analysis for Zero-Power Physics Testing (ZPPT) operations. For those operations not specifically addressed by the FSAR, a safety analysis has been performed. The combination of this report and the LOFT FSAR is a basis for the Mode 5 Technical Specifications.

57039 (LTR—113-50) **LOFT reflood as a function of accumulator initial gas volume.** Rhodes, H.F. (Idaho National Engineering Lab., Idaho Falls (USA)). 1 Jun 1978. Contract EY-76-C-07-1570. 243p. (RE-A—78-022). Dep. NTIS, MF A01.

Portions of document are illegible.

The effect of the initial gas volume in the LOFT accumulators on the time to start of core reflood, after a LOCA, has been studied. The bases of the calculations are the data used and results presented in the Safety Analysis Report, Rev.1, August 1977, and the data in the RELAP and TOODEE2 program input and output listings. The results of this study show that an initial nitrogen volume of 12 cu ft, or more (at 600 psig initial pressure), would cause start of core reflood in time to prevent the cladding temperature from reaching 2200°F. The 12 cu ft initial volume will expand from 600 psig, initial pressure, to about 10 psig (containment pressure shortly after start of LOCA is approximately 8 psig) when all ECC liquid has been expelled from the accumulator. This pressure margin is considered too small; the ECC flowrate will be zero before the accumulator is empty.

57040 (TID—28485) **Comparison of "best-estimate" and "evaluation model" loca calculations: the BE/EM study.** Johnsen, G.W.; Childs, F.W.; Broughton, J.M. (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1976. Contract EY-76-C-07-1570. 189p. Dep. NTIS, PC A01/MF A01.

The report documents the results of the initial part of a study of quantitative differences between current "best-estimate" (BE) and "evaluation model" (EM) analyses of a postulated loss-of-coolant accident occurring in a reference pressurized water reactor. The report includes the purpose, ground rules, and assumptions; delineation of the mathematical models; presentation and interpretation of results; and conclusions. The work is limited to blowdown and refill and an overall comparison of the calculation techniques.

57041 (TREE—1116, pp 291-307) **Loss of fluid test.** Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Progress in physics calculations and the development of computer programs for LOFT experiments is summarized.

57042 **Water moderated reactor.** Berens, T.; Mansson, R. (to Aktiebolaget Asea-Atom). US Patent 4,093,513. 6 Jun 1978. Priority date 29 Aug 1974, Sweden. 2p.

In a water moderated reactor, which has a plurality of vertically arranged fuel assemblies enclosed in a moderator tank provided with a cover and positioned by an upper core grid, a sprinkling device is arranged above the core grid and below the cover. The sprinkling device is composed of a plurality of substantially horizontal main sprinkling tubes each provided with a plurality

of nozzles. A common distributing pipe supplies sprinkling water to the main sprinkling tubes. There are auxiliary tubes above the main sprinkling tubes and connected to them hydraulically and mechanically by a plurality of transverse metal tubes. The cover has a detachable lower part in the form of a ring to which the sprinkling device is connected.

57043 Mobile nuclear reactor containment vessel. Thompson, R.E.; Spurrier, F.R.; Jones, A.R. (to Westinghouse Electric Corp.). US Patent 4,088,535. 9 May 1978. Filed date 9 Feb 1977. 4p.

A containment vessel for use in mobile nuclear reactor installations is described. The containment vessel completely surrounds the entire primary system, and is located as close to the reactor primary system components as is possible in order to minimize weight. In addition to being designed to withstand a specified internal pressure, the containment vessel is also designed to maintain integrity as a containment vessel in case of a possible collision accident.

57044 Sealed heat access area enclosure. Golden, M.P.; Govi, A.R. (to Dept. of Energy). US Patent 4,078,968. 14 Mar 1978. Filed date 28 Jul 1976. 6p.

PAT-APPL-709,351.

A liquid-metal-cooled fast breeder power reactor is provided with a sealed head access area enclosure disposed above the reactor vessel head consisting of a plurality of prefabricated structural panels including a center panel removably sealed into position with inflatable seals, and other panels sealed into position with semipermanent sealant joints. The sealant joints are located in the joint between the edge of the panels and the reactor containment structure and include from bottom to top an inverted U-shaped strip, a lower layer of a room temperature vulcanizing material, a separator strip defining a test space therewithin, and an upper layer of a room temperature vulcanizing material. The test space is tapped by a normally plugged passage extending to the top of the enclosure for testing the seal or introducing a buffer gas thereinto.

57045 General philosophy of risk. Farmer, F.R. (UKAEA Reactor Group, Culcheth). pp 1-3 of Heat and fluid flow in water reactor safety. London; Mechanical Engineering Pub. for the Institution of Mechanical Engineers (1977).

From TDFM group meeting on heat fluid flow in water reactor safety; Manchester, UK (13 Sep 1977).

Some of the issues in water reactor safety which influence safety research are considered. If research were determined only by cost of potential error, then most effort would be devoted to accident related studies. Perhaps too much money is already invested in the improbable event, and the theme developed endeavours to relate effort to a probability based potential loss. The study of transient events is costly and it is difficult to define the field of interest sufficiently well to convince the critic. It is impossible to prove that all accidents have been considered and that all models represent real situations. There is a recognition of risk of injury or death in work and play, not so clear a recognition that risk must be accepted in terms of uncertainty in data in accident analysis and in our perception. There is some attempt to match, at least qualitatively, the degree of uncertainty with the probability weighted penalty of error.

ENERGY STORAGE

MAGNETIC

REFER ALSO TO CITATION(S) 58071

COMPRESSED GAS

REFER ALSO TO CITATION(S) 56937

57046 (CONF-780599—3) **Parametric analysis of turbomachinery options for compressed air energy storage plants.** Kim, C.S.; Kartsounes, G.T. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 35p. Dep. NTIS, PC A03/MF A01.

From CAES technology symposium; Pacific Grove, CA, USA (15 May 1978).

A parametric study of possible turbomachinery options for compressed air energy storage plants is presented. The plant is divided into the four subsystems: a turbine system, compressor system, motor/generator, and an underground air storage reservoir. The turbine system comprises a high-pressure turbine, a low-pressure turbine, two combustors, and a recuperator. The compressor system comprises a low-pressure compressor, high-pressure compressor, booster compressor, intercoolers, and an aftercooler. A water-compensated mined cavern constitutes the underground air-storage reservoir. Plant performance is presented in terms of five parameters: specific air flow rate, specific heat rate, specific storage volume, specific compression rate, and overall plant efficiency. The capital and operating costs of the plant as a function of the turbomachinery options are presented. Design variables of the turbomachinery are the reservoir pressure and inlet gas temperatures to the turbines.

57047 (PNL—2685) **Preliminary stability criteria for compressed air energy storage in porous media reservoirs.** Stottlemyre, J.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 82p. Dep. NTIS, PC A05/MF A01.

Results from the initial phase of a study to establish subsurface design and operating criteria for a Compressed Air Energy Storage (CAES) facility are summarized. The primary objective was to derive a preliminary set of criteria that would help ensure the long term (30 to 40 year) integrity of CAES reservoirs in porous media, such as aquifers or abandoned natural gas reservoirs. In addition, appropriate research and development tasks were to be defined if the current technology was found to be inadequate. Preliminary stability and design criteria for storage of compressed air in porous media were determined on the basis of a survey of the open literature and the experience of experts in industry and universities. The results were separated into two categories: criteria for low temperature air injection (under 200°F) and criteria for high temperature air injection (200 to 650°F). Results are presented as maximum and/or minimum bounds for a number of parameters such as porosity, permeability, closure, storage pressure, caprock thickness, delta pressure, and caprock slope. One of the prime conclusions derived from an evaluation of the low temperature concept is that the technology currently exists to handle the potential design and operating problems. Therefore, there appears to be no technical roadblocks to the successful demonstration of the CAES concept, and a pilot project could be constructed in the near future.

THERMAL

57048 (ORNL/TM—6509) **Low-temperature thermal energy storage program annual progress report for period, October 1976—September 1977.** Hoffman, H.W.; Kedl, R.J.; Fraley, S.K. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 79p. Dep. NTIS, PC A05/MF A01.

The Low-Temperature Thermal Energy Storage (LTTES) Program is a part of a national effort to develop means for reducing U.S. dependence on oil and natural gas as primary energy soures. To this end, LTTES addresses the development of advanced sensible and latent heat storage technologies that permit substitution by solar or off-peak electrical energies or conservation by recovery and reuse of waste heat. Emphasis is on application of these technologies to building heating and cooling. The LTTES Program continued to mature. A number of technologies were identified for development emphasis; thus: (1) seasonal storage in aquifers of hot and cold water from waste or natural sources; (2) short-term or daily storage in phase-change materials of heat or coolness from solar or off-peak electrical sources; and (3) recovery and reuse through thermal storage of rejected industrial heat. These areas have been further divided into three major and four minor thrusts; significant accomplishments are reported for each thrust.

CHEMICAL

REFER ALSO TO CITATION(S) 57048, 57287

57049 (SAND—78-8505) **Recent advances in thermochemical energy storage and transport.** Bramlette, T.T. (Sandia Labs., Livermore, CA (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780801—22). Dep. NTIS, MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Portions of document are illegible.

A brief overview of the thermochemical energy storage and transport (TEST) program and a summary of the major results obtained to date are presented. Activities summarized included systems studies, basic research, and large scale component development projects for a number of chemical reaction systems and a variety of energy sources and applications. It is anticipated that as more information is obtained regarding the reaction systems, energy sources, and applications, the emphasis of the TEST program will shift from studies of this type to the large scale demonstration of the more promising concepts.

BATTERIES

DESIGN AND DEVELOPMENT

57050 (ANL—78-21) **High-performance batteries for stationary energy storage and electric-vehicle propulsion. Progress report, October—December 1977.** (Argonne National Lab., IL (USA)). Mar 1978. Contract W-31-109-ENG-38. 89p. Dep. NTIS, PC A05/MF A01.

Research, development, and management activities of the program at Argonne National Laboratory (ANL) on lithium/metal sulfide batteries during the period October to December 1977 are described. These batteries are being developed for electric-vehicle propulsion and stationary energy storage. The present cells, which operate at 400 to 500°C, are of a vertically oriented, prismatic design with a central positive electrode of metal sulfide (usually, FeS or FeS_2), two facing negative electrodes of lithium-aluminum alloy, and an electrolyte of molten LiCl-KCl. A major objective of the program is to transfer the technology to industry as it is developed, with the ultimate goal of a competitive, self-sustaining industry for the commercial production of lithium/metal sulfide batteries. Technology transfer is being implemented by several means, including the assignment of industrial participants to ANL for various periods of time and the subcontracting of development and fabrication work on cells, cell components, and battery testing equipment to industrial firms.

PERFORMANCE AND TESTING

57051 (AD-A—049445) **Engineering evaluation tests of 3-4 ampere-hour sealed lead—acid batteries: Elpower, ESB, Eagle-Picher, Globe Union, and Gates.** Goodman, A.W. (Naval Weapons Support Center, Crane, IN (USA). Weapons Quality Engineering Center). 7 Dec 1977. 15p. (WQEC/C—77-395). NTIS PC A02/MF A01.

The program objective was to evaluate and determine high rate capability, low temperature performance, a plot of discharge time versus various discharge rates, life cycle capability, and charging requirements.

57052 (SAND—78-0084) **Mg/FeS_2 system for thermal batteries.** Bush, D.M. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

Sixty-minute thermal batteries that use the $Ca/CaCrO_4$ system have been developed at Sandia, but this system has two drawbacks for long-life applications. A liquid alloy forms after activation that can short the cells, and there are side chemical reactions which generate an unpredictable amount of heat. Argonne National Laboratory is working on molten salt secondary cells, and one of the most promising systems in $LiAl/FeS_2$. To adapt iron disulfide as a cathode material in pellet-type thermal batteries, magnesium was chosen as the anode because of its ease of handling and known performance. Once this is accomplished, LiAl or another anode material can be substituted for the magnesium. Mg/FeS_2 cells were developed that had lives of 80 minutes to 80 percent of peak voltage at 50 mA/cm^2. This is twice that obtained with $Ca/CaCrO_4$, but cell voltage is lower. There was no loss in capacity at the higher current densities of 100 and 150 mA/cm^2. Cells were tested over a temperature range from 440° to 600°C. Performance was good above 480°C with shorter life at 460°C and below. Eighty-four batteries with ten 50-cm^2 cells were assembled and tested. Typical life to 75 percent of peak voltage was 25 minutes at 50 mA/cm^2. While this is respectable performance for a thermal battery, the single-cell results indicate that considerable improvement is possible. 11 figures, 8 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 57052

57053 Behavior of the Li/Li^+ electrochemical system subject to anodic and cathodic polarization cycles in a solution of lithium perchlorate and propylene carbonate. Garreau, M.; Thevenin, J.; Warin, D. *C. R. Hebd. Seances Acad. Sci., Ser. C;* **286**: No. 21, 545-548(29 May 1978). (In French).

Optimal conditions of lithium electrode behavior in a secondary battery using this metal as the negative electrode are studied. In particular, the influence of the substrate nature is defined and the maximum current densities and electricity amounts are determined in order to avoid a quick alteration of the metal—electrolyte interface during the cycling operations. 2 figures.

57054 Rechargeable electrochemical cell with cathode of stoichiometric titanium disulfide. Whittingham, M.S. (to Exxon Research and Engineering Co.). US Patent 4,084,046. 11 Apr 1978. Filed date 17 Mar 1976. 8p.

Stoichiometric titanium disulfide having a high degree of crystalline perfection and particularly suited for use as an active cathode material is prepared by heating particulate metallic titanium to a reaction temperature between about 475° and 600°C contacting the heated titanium with an atmosphere having a sulfur partial pressure substantially equal to the equilibrium sulfur partial pressure at the reaction temperature to form titanium disulfide, and maintaining the reactants at the reaction temperature sufficiently to insure complete reaction. A battery is described which employs a lithium anode, an electrolyte of lithium perchlorate dissolved in an organic solvent, and stoichiometric titanium disulfide having a single hexagonal phase and a particle size surface area between about 2 and 4 square meters per gram.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 56595, 56737

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 57056, 57076, 57106

57055 (NP—23290) **Constrained input—output simulations of energy restrictions in the food and fiber system. Agricultural economic report No. 280.** Penn, J.B.; Irwin, G.D. (Department of Agriculture, Washington, DC (USA)). Feb 1977. 17p. Dept. of Agriculture, Washington, DC.

The energy shortages of the recent past have prompted a keen awareness of the pervasiveness of direct and indirect energy utilization in the domestic economy. Analysis of the relationship of energy to various components of the economic system requires treatment of the components in a total economic setting. Since the United States has a consistent set of national income accounts and their production account transforms into a sectoral input-output (I/O) tableau, I/O techniques appear to be a feasible way of incorporating this interrelatedness. The model utilized in this study is the readily available I/O construct incorporated into a linear-programming framework and appended with Btu energy requirements and employment and value-added data. The impacts of energy resource shortages are explored for a representation of the food and fiber system in the context of sector interdependence.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 56939, 57060, 57069, 57093

57056 (EPRI-EA—626(Vol.1)) **Stanford PILOT energy/economic model.** Dantzig, G.B.; Connolly, T.J.; Paarikh, S.C. (Stanford Univ., CA (USA). Dept. of Operations Research). May 1978. 63p. Dep. NTIS, PC A04/MF A01.

PILOT is a U.S. national energy/economic model that compares various policy decisions by measuring their impact on the standard of living. Through its dynamic linear-programming formulation, the modeled economy allocates industrial output to consumption and to capital formation in the current period to achieve the highest standard of living over the planning period. The "take home" or consumption income is used to measure the standard of living. The model consists of a detailed description of energy technologies and a less-detailed description of other economic sectors, investments, government, and final consumption. In particular, there is an explicit representation of the exploration and extraction processes for oil, gas, and uranium; there is an accounting over time of reserves and capital formation. Foreign trade balance is treated endogenously. Final consumption is represented by consumption vectors that vary with increasing level of income. Three sets of input conditions are used to illustrate the behavior and capabilities of the model. The assumptions for the base case and two variations were developed. One of the cases assumes a higher and another a lower availability of primary energy than that assumed for the base case. The general conclusion on the supply side is that the availability of primary energy can have an important effect on the future standard of living. On the demand side, successful implementation of conservation measures can significantly increase the standard of living for the same amount of energy made available to the general economy. The model outputs are schedules of economic activity, imports and exports, raw energy extraction, new construction, and production of various conversion processes.

57057 (Y/OWI/SUB—78/22336/P1) **Community conflict in the nuclear power issue.** Burt, R.S. (California Univ., Berkeley (USA). Dept. of Sociology). May 1978. Contract W-7405-ENG-26. 66p. Dep. NTIS, PC A04/MF A01.

This is the first of a two part discussion the purpose of which is to demonstrate that a frankly structural, or network, approach to the analysis of community decision-making allows an observer to anticipate and manage community response to specific policies. Here I am concerned with anticipating community response. In part two (Burt, 1978), I am concerned with conflict resolution strategies. The specific policy used as illustration is siting nuclear power facilities. Published accounts of siting nuclear facilities are used to identify basic social parameters of the nuclear power issue as a community conflict. Changes in the form and content of relations in the network among opponents and proponents of a facility are described. Subsequently, the description is used to specify a causal model of the manner in which conflict escalation is promoted or inhibited by the characteristics and leadership structure of a community in which a nuclear facility is proposed. Hypotheses are derived predicting what types of communities can be expected to become embroiled in conflict and the process that conflict escalation will follow.

57058 Effects of urbanization on agricultural activities. Berry, D. (Regional Science Research Inst., Philadelphia). *Growth and Change;* 9: No. 3, 2-8(Jul 1978).

Statistical evidence from three Middle Atlantic states is used to describe the direct and indirect pressures of urbanization on agricultural land and activities. Direct effects are an increase in population and a conversion of farming land to urban uses. Indirect effects involve changes in attitudes about farming, changes in the status of farmers, and land speculation. Data on the effects of idled farmland and comparisons of the agricultural activities of rapidly growing and slowly growing areas illustrate these effects. Modifications of the effects to retain farmland would probably require direct control of land use and could be accomplished through zoning, differential assessment, or public purchase of farming land. 36 references.

57059 International taxation of multinational enterprises in developed countries. Adams, J.D.R.; Whalley, J. Westport, CT; Greenwood Press (1977). 186p. $19.95.

Project initiated and guided by the Institute for Fiscal Studies.

The authors, specialists in law and economics, respectively, adopt an interdisciplinary approach to the international taxation of multinational corporations in developed countries, with particular emphasis on the EEC and the United States, integrating both legal and economic aspects of the subject. Since the international nature of the activities of multinational companies brings them within the scope of the domestic tax provisions of different countries, the authors outline the principles behind the domestic tax treatment of companies, and then assess the economic impact of this treatment. They subsequently examine the international taxation of multinationals, paying special attention to the OECD model treaty which seeks to remove the problem of international double taxation; reactions of governments to each other's fiscal policies are also examined, with special attention being paid to tax havens. Finally, they look at the EEC proposals for the harmonization of corporate tax systems within the Community and postulate how these proposals would operate if put into effect. There are numerous examples throughout the book of international taxation at work, and these together with the clear text provide a readily comprehensible account of a subject that can seem highly complicated to the uninitiated.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 56559, 56883, 56950, 57090, 57091

57060 (NTIS/PS—78/0273) **Financing and taxation for urban control of pollution (a bibliography with abstracts). Report for 1964—March 1978.** Lehmann, E.J. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 198p.

The citations relate to urban and regional planners who wish to study means of financing pollution abatement programs and of taxing sources as a means of pollution reduction. The reports are divided into three sections: Air pollution studies, solid waste disposal studies, and water pollution and sewage treatment studies. (This updated bibliography contains 193 abstracts, 17 of which are new entries to the previous edition.)

57061 River quality assessment: implications of a prototype project. Rickert, D.A. (Geological Survey, Portland, OR); Hines, W.G. *Science;* **200**: No. 4346, 1113-1118(9 Jun 1978).

The U.S. Geological Survey recently completed an intensive river quality assessment study of the Willamette River basin, Oregon. The most noteworthy finding was that across-the-board advanced waste treatment was not the answer to the problem of meeting stringent water quality standards established for the Willamette River. This implies that rigid nationwide standards and regulations are likely to result in unneeded expenditures in some river basins and in unachieved standards in others. It was also found that existing water quality data collected under monitoring- and surveillance-type programs are inadequate for defining the critical cause-effect relationships that control river quality problems. Intensive, synoptic surveys keyed to local problems and conditions are required to provide an adequate information base for making key management decisions. 17 references.

57062 Critical choices for energy and wildlife. Hatcher, R.M. *Tenn. Wildl.;* **1**: No. 4, 1-7(1978).

The potential impact of fourteen new energy options (some applicable to Tennessee) on fish and wildlife are identified and evaluated by a rating system. The following ratings were given: oil shale (-123), coal synthetic fuels (-90), coal steam plants (-60), coal magnetohydrodynamics (-47), petroleum products (-33), nuclear fission (-28), tidal energy (-24), geothermal energy (-22), nuclear fusion (-4), solar energy (-2), hydroelectricity (0), wind energy (0), ocean thermal conversion (+3), and solid wastes (+4). Solutions to the environmental problems should be sought for all energy sources, with emphasis given to gradually substituting solar and other promising sources for the conventional sources. A carefully planned transition, lasting 25 to 50 years, could avoid environmentally harmful emergency programs.

57063 CO_2 and Spaceship Earth. Terra, S. *EPRI J.;* 3: No. 6, 22-27(1978).

Atmospheric CO_2 concentrations have increased so rapidly since the start of the industrial revolution that the threat of climatic and economic disruptions may require limitations on future fossil-energy production. The greenhouse effect by which longwave radiation is absorbed by CO_2 and reradiated back to earth, will raise the earth's temperature. Other factors can be traced to a warming trend caused by an increase in nitrous oxides from agricultural activity and a cooling tendency as the added warmth increases evaporation and cloud formation. Several national and international studies of CO_2 effects are underway and legislation for further data and research has been proposed in Congress. While scientists agree that CO_2 levels are increasing, they disagree on the nature of the long-term effects on climate, crop production, deglaciation, and the impact of forest and other biological matter. Simulation models for projecting future conditions need to include transients to predict the effects of CO_2 level changes.

57064 Coastal resources: management; institutions and programs. Heikoff, J.M. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1977). 300p. $16.50.

This study examines the 1972 Coastal Zone Management Act and the different ways in which three states--Maine, Rhode Island, and Washington--have tried to implement it. Special attention is paid to state agency structures, state supervision of local land-use regulation, the integration of resources management in the coastal zone and statewide, and public participation in program development. Persons in public administration will be interested in the details of the Federal Coastal Zone Management Act and the three state programs described. Environmental organizations will appreciate the discussion of Federal and state efforts to conserve coastal resources, while urban and regional planners will find the discussions on resources analysis and planning valuable. Government agency officials will be interested in descriptions of how various aspects of coastal resources management are integrated to protect wildlife and recreation areas, and to guide controlled economic development.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 57058, 57061, 57064

57065 (AD-A—051324) **Energy atlas of Colorado. Final report.** Smith, C.L.; Christenson, J.G.; Taylor, J.W.; Wagner, J.R. (Air Force Academy, CO (USA)). Sep 1977. 20p. (USAFA-TR—77-15). NTIS PC A02/MF A01.

This report presents the locational aspects of the energy resources available in Colorado. Resources include coal, oil and gas, uranium, oil shale and water. The location of power plants and power transmission lines are also indicated as are those for water resources.

57066 (CONF-7706130—) **U.S. options for long-term energy supply. Program report, volume 3, number 10.** (Atomic Industrial Forum, Inc., Washington, DC (USA)). 1977. 420p. Atomic Industrial Forum, Inc., Washington, DC.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

Some introductory remarks were made by W. Kenneth Davis on the subject of the conference and on Session 1, new energy policy from a new administration. He stressed that the conference deals with the whole energy situation—not just nuclear energy. To begin

Session 1, George Rathjens presented the opening address and was charged with reviewing the Ford/Mitre nuclear power study. A separate abstract was prepared for each of 19 papers included under subjects such as policies, breeder concepts, conservation, solar energy, fusion power, and fission reactors. (MCW)

57067 Optimal risk sharing and the leasing of natural resources, with application to oil and gas leasing on the OCS. Leland, H.E. *Q. J. Econ.;* **92**: No. 3, 413-437(Aug 1978).

Future natural resource discoveries will most likely take place on public lands. Rights to potential oil and gas resources are transferred from the public to private firms through a lease; the lease specifies the nature of the rights granted. Federal offshore leases have specified that firms pay a royalty equivalent to one-sixth of the value of production. This royalty has remained unchanged since offshore leasing began, despite the significant changes in the value of tracts as reflected in winning bids. Leases of other countries specify quite-different payment schedules, with profit rather than production often determining the amount to be paid. Clearly, alternative forms of conditional payments have differing implications on risk sharing and on the exploration, development, and production decisions of firms. This paper develops a general theory of optimal lease payments, paying special attention to royalty and profit-share payments, since they are featured prominently in proposals for new Federal leasing policies.

57068 China reveals long-term energy development plans. Smil, V. (Univ. of Manitoba, Winnipeg). *Energy Int.;* **15**: No. 8, 23-25, 29(Aug 1978).

Post-Mao China is emphasizing rapid expansion of industry and government officials are pushing domestic oil and coal production to meet the increase in energy demand. Modernization of the coal industry will include raising productivity at existing mines, mechanization of the 20,000 small rural mines, new self-sufficiency in coal production of the southern provinces, use of low-quality fuels and mining wastes, and mechanization of coal preparation and handling techniques. Plans for the petroleum industry are equally ambitious with a drive to find new reserves and modernize the industry. A review of recent developments notes that abundant fossil fuels and hydro sites have not required immediate plans for nuclear power generation, although the attitude toward nuclear energy is positive. The new Sino-Japanese trade treaty will result in a transfer of technology and products to China in return for raw materials.

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 56375, 57089, 57090

57069 (COO—2708-013-1) **Private sector participation in Federal energy RD and D planning.** (National Research Council, Washington, DC (USA). Committee on Private Sector Participation in Government Energy RD and D Planning). 1978. Contract EY-76-C-02-2708. 113p. Dep. NTIS, PC A06/MF A01.

The present study was started early in 1977 in response to a need expressed by the then Assistant Administrator for ERDA Planning, Analysis, and Evaluation and was endorsed by the Administrator of ERDA. The primary purpose is to explore various institutional alternatives that might be employed by the Federal government and the private sector to provide an effective coupling between the requirements of the private sector for new energy technologies and the government's planning process to develop these technologies. This also included an analysis of several institutional initiatives that have been tested by ERDA to create an effective working relationship with industry. Based on these studies, the Committee was requested to make recommendations on an appropriate institutional mechanism to improve the planning process. Chapters are entitled: The Government Role in Energy RD and D; The ERDA (DOE) Private Sector RD and D Planning Interface; Industry Perceptions of the ERDA/Private Sector Interface; Legal Constraints to DOE/Private Sector Cooperation; Instability as a Constraint to DOE/Private Sector Cooperation; and the RD and D Planning Process. An analysis of five legal problems in structuring private sector participation in joint RD and D planning is discussed in an appendix.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 56627, 56630, 56632, 56650, 56659, 56698, 56699, 56935, 56950, 56987, 57003, 57004, 57005, 57006, 57057, 57086, 57097, 57100, 57107, 58047, 58048, 58049, 58050, 58056, 58076, 58077

57070 (CONF-7706130—, pp 23p, Session 1, Paper 3) **Alternate perspective on long-range energy options.** Culler, F.L. (Oak Ridge National Lab., TN). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The author emphasizes that, in his opinion and that of the industrial segment of the economic establishment, nuclear energy will be needed to replace in part the rapidly diminishing supplies of oil and gas. To maintain the nuclear option, breeders are necessary, he continues. With uranium of recoverable grade in limited supply Mr. Culler says that prudent planning should include the demonstration of the breeder option, which must also provide efficient and safe reprocessing, fuel recycle, and radioactive waste disposal. (MCW)

57071 Psychology of nuclear safeguards. Parker, L. (Univ. of Manchester, Eng.). *New Sci.;* 460-461(17 Aug 1978).

There is an essential confusion in the way we look at safeguards. They cannot guarantee to prevent diversions: at best, they can deter. While successful acts of deterrence pass unnoticed, failures will be widely publicized. Therefore, we will judge safeguards systems not on a fair balance between their successes and failures, but exclusively on what we believe to be their failures. Effectively, we will be demanding an impossibly high standard of performance, and safeguards authorities will be tempted to conceal diversions rather than disappoint our expectations. Perhaps it is appropriate that safeguards are primarily psychological instruments: Parker argues that their essence is credibility, and that this does not necessarily depend on the hard reality of their performance. Brian Johnson claimed (New Scientist, vol 74, p 189) that safeguards have engendered a sense of security by linking the commitment of many states not to develop nuclear weapons, and that the Non-Proliferation Treaty has helped condition domestic political attitudes against starting up nuclear weapons programs. Perhaps the common view that safeguards are legal instruments has served the psychological purpose of supplying a language in which states with widely differing interests can explore the fundamental incompatibility between non-proliferation and the search for convenient energy sources. If this is true then it cannot be said that the NPT is a failure, merely that its success does not correspond to its apparent purposes.

57072 Australia prepares for uranium mining. Scott, W.E. *Energy Int.;* **15**: No. 8, 20-22(Aug 1978).

Six bills represent the Australian Government's legislative program for setting environmental policies that will permit uranium mining. The bills provide for coordinated research and monitoring activities, leasing of park lands and aboriginal land claims, application of nuclear safeguards, protective measures for health and safety, and enforcement of environmental requirements. Australia's goal is an orderly and responsible development of its sizeable uranium resources, estimated at 20% of the resources of the Eastern Hemisphere. Scientists are making projections of nuclear power generating capacity and enrichment facilities on the basis of the pending legislation.

57073 Birth and early history of nuclear power. Kenton, J.E. (Electric Power Research Inst., Palo Alto, CA). *EPRI J.;* **3**: No. 6, 7-15(1978).

The history of nuclear generation of electric power is traced from Sir Ernest Rutherford's first pessimistic assessment in 1933 to the present time, when 12% of U.S. electricity comes from nuclear plants. The U.S. Navy is credited with being the first to see the potential for nuclear power reactors for submarine propulsion. The author relates the story of the Manhattan Engineering District during World War II and traces the nuclear submarine development as it paralleled postwar civilian power programs from the first light water reactors to the present controversy over the breeder reactor. The momentum of technology development is seen to have slowed, possibly because the 1955 success of the USS Nautilus prompted world acceptance of the LWR as the dominant power reactor.

57074 To breed, or not to breed. Weinberg, A.M. (Inst. for Energy Analysis, Oak Ridge, TN). *Across the Board;* **14**: No. 9, 4-12, 14-24(Sep 1977).

Dr. Weinberg, reviewing the development of nuclear energy since his involvement in the Manhattan Project that began in 1942, describes the golden vision that saw the transition to a second phase of unlimited energy provided by breeder reactors. He explains in depth the problem of the self-limiting nature of uranium-based technology and the present dependence on uranium-235-fueled light water reactors. Breeder reactors capable of fueling an expanding nuclear industry are fueled by the more-plentiful uranium 238. The ability of the breeder reactor to produce more energy and eliminate resource uncertainty was assumed to make it more cost-effective and to justify a larger capital investment. Dr. Weinberg gives a general description of breeder research programs, followed by a discussion of the major issues of opponents: proliferation, waste disposal, toxicity, reactor safety, and economics. Recognizing the dilemma en-

tailed, he outlines five steps for proceeding with Phase II. These would involve limiting the land area committed to radioactive operations, restructuring the nuclear industry, imposing heavy security, training a professional cadre, and insuring immortality to the responsible institutions.

57075 Nuclear power and weapons proliferation: the thin link. Starr, C. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 26-33(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Dr. Starr, in discussing the thin link between nuclear power and weapon proliferation, stated that the U.S. in postponing the breeder reactor option is depriving energy-hungry nations of the full benefit of nuclear power. Well-known facts show that there are about eight different ways available to produce weapons material. By the 1980s, there will be even more easier and cheaper ways to produce weapon-grade fissionable material. The Administration's policy on nuclear power has the effect of promoting LWRs and delaying both plutonium recycle and the breeder. The LWR fuel would pass through the reactor only once, and then be stored indefinitely. Because the uranium resource future is uncertain, many believe the insurance aspect of the breeder option (which requires recycle) should be fully developed now and subsequently used as required. The Administration's counter argument is that closing the plutonium fuel cycle, as required for a fully developed breeder system, would place the United States in the position now of endorsing plutonium recycle, and thus encourage the development in other nations of a possible channel for supplying nuclear weapons material. It is also the Administration's contention that domestic pursuit of the breeder and recycle for United States energy supply and simultaneous discouragement of other nations would create an unacceptable double standard—although such already exists in the nuclear weapons field. Many have a deep concern that the Administration's position on plutonium recycle and the breeder will be internationally counterproductive and actually stimulate proliferation; it may damage our domestic economy as well, the author says. (MCW)

TRANSPORT AND STORAGE

57076 (TID—28599) **Report on capital requirements for transportation of energy materials.** (Transportation and Economic Research Associates, Inc., Arlington, VA (USA)). 9 Jun 1978. 263p. Dep. NTIS, MF A01.

Portions of document are illegible.

The study obtains and organizes sufficient data so that costs of expanding capacity in transportation of energy materials can be determined in a way designed to meet the needs and requirements of the Project Independence Evaluation System (PIES) model. Requirements for capital expenditures are computed for three modes of transport in five computer-based algorithms: oil pipeline investment; gas pipeline investment; rail car and locomotive investment; coal barge and collier investment; and oil barge and tanker investment. Necessary data and assumptions are organized within the context of each algorithm either as a separate data base or written into the program as suits the nature of the mode and the output information obtainable from PIES. The only exception to this concerns track and railbed improvements, the need for which cannot be predicted on the basis of information derived from PIES outputs. The approach in the algorithm logic differs considerably between the modes. Each chapter is dedicated to a different mode, Chapter II to Pipeline Transportation, Chapter III to Water Transportation, and Chapter IV to Railroad Transportation. Each chapter opens with an introduction on the salient characteristics of the mode followed by a discussion of the logic of the algorithm, and data sources and assumptions. A brief overview of the methods employed in the modal analyses and their relationships to PIES are given.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 57133, 57134

CONSERVATION

REFER ALSO TO CITATION(S) 57066, 57103, 57108, 57123

57077 (CONF-7706130—, pp 9p, Session 3, Paper 1) **Energy conservation: the greatest energy resource.** Schipper, L. (Lawrence Berkeley Lab., CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

A packet was presented at the Forum including 3 document types by Lee Schipper. The Best Energy Policy, Waste Not, Want Not was an article in the Washington Post, April 10, 1977 describing how a national conservation program could cut needs without creating hardships. After a reprint of this article is given, a book review he wrote on The Transitional Storm, Edison Electric Institute, for Energy Research Reports, April 18, 1977, is presented. In sum, he found the prestigious authors exhibiting woeful pre-embargo thinking. Finally, a statement on the Carter Conservation Proposals finds Schipper saying the President's emphasis on conservation is proper and long overdue. Conservation is less costly than new supplies—the President's program will ultimately cost far less than continuation of emphasis on costly supplies alone, as has been the policy in the past. (MCW)

57078 (CONF-7706130—, pp 24p, Session 3, Paper 3) **Engineer's view of conservation and solar energy.** Tedmon, C.S. Jr. (General Electric Co., Schenectady, NY). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

Solar energy and energy conservation will play important roles in the U.S. energy crisis, but the author, in concluding that neither will solve the energy problem, puts those notions in perspective. Sunshine is free, but solar energy is not, he says, and for many years to come it will be one of the most-expensive forms of energy. The economic justification to conservation measures is complex. Suggestions are made as to what conservation can do to help maintain energy viability. Some projections about the rate of solar technologies in the future are made. Energy requirements in 2000 A.D. are briefly examined. (MCW)

57079 (DOE/CS—0033/1) **Industrial Energy Efficiency Improvement Program annual report.** (Department of Energy, Washington, DC (USA). Div. of Industrial Conservation). Jun 1978. 35p. Dep. NTIS, PC A03/MF A01.

This annual report provides a detailed summary of industrial energy conservation progress, as required by the Energy Policy and Conservation Act (EPCA), PL 94-163, enacted on December 22, 1975. Title III, Part D of the EPCA requires the DOE to establish a program to promote increased energy efficiency by American industry. The program includes the identification and ranking of the major energy-consumptive manufacturing industries (on the basis of 2-digit SIC codes), the establishment of energy efficiency improvement targets for at least the 10 most energy-consumptive industries, the identification of major energy-consumptive corporations within those industries for the purpose of determining those which must report progress in improving energy efficiency, and the establishment of a reporting system. A tabulation of the final targets, at the two-digit SIC level, for the 10 most energy-intensive industries shows for the food and kindred products, 12%; textile mill products, 22%; paper and allied products, 20%; chemical and allied products, 14%; petroleum and coal products, 12%; stone, clay and glass products, 16%; primary metal industries, 9%; fabricated metal products, 24%; machinery, except electrical, 15%; and transportation equipment, 16%. In terms of total energy usage, the targets represent potential savings of energy in 1980. (MCW)

57080 (HCP/W1152—01) **Year-end report: National Energy Peak-Leveling Program (NEPLP).** (Engineering Supervision Co., Los Angeles, CA (USA)). Jun 1978. Contract EY-76-C-03-1152. 181p. Dep. NTIS, PC A09/MF A01.

Progress is reported on the project to perform energy audits in five diverse building complexes in the central-city areas of downtown Los Angeles: Occidental Center, United California Bank, The May Company, The Southern California Gas Company, and the Department of Water and Power. The project has demonstrated the willingness of individual building owners and their operating personnel to mutually join--without a directive--in a cooperative energy-conservation venture under the anticipated computer-directed control. The technical expertise to support the ownership-management objectives has been demonstrated. Moreover, it has been shown that personnel at the operating level can function as a team with a high degree of mutual cooperation under centralized technical cooperative direction. (MCW)

57081 (LBL-W—7818-1/2) **Updated Project Conserve Audit System. Volume I. System documentation.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Applied Urbanetics, Inc., Washington, DC (USA)). May 1978. Contract W-7405-ENG-48. 714p. Dep. NTIS, PC A99/MF A01.

The Home Energy Audit System (HEA), a software system, is a cooperative effort of the National Bureau of Standards and Applied Urbanetics, Inc. It is anticipated that this system will be sponsored by a variety of public and private organizations such as the Federal, state, and local governments as well as such private organizations as financial institutions and utilities. Design of the

system will allow the computer processing to be run on IBM, CDC, or UNIVAC computer equipment. The objective of the system is to provide a capability that will take information from a homeowner questionnaire, process the information, and develop a list of recommendations in the form of a Homeowner Report. The recommendations will highlight cost-effective data for such actions as: insulation, storm windows and doors, caulking and weather stripping, water heater insulation, and solar water heating. Annual savings will be identified. The forerunner of HEA was Project Conserve. (MCW)

57082 (LBL-W—7818-2/2) **Updated Project Conserve Audit System. Volume II. Appendices.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Applied Urbanetics, Inc., Washington, DC (USA)). May 1978. Contract W-7405-ENG-48. 534p. Dep. NTIS, PC A23/MF A01.

The Home Energy Audit System, a software system, formerly termed Project Conserve (FEA), is to provide a capability that will take information from a questionnaire, process the information, and develop a list of recommendations in the form of a Homeowner Report. This document contains 31 appendices. Appendix A is a copy of the questionnaire that will be mailed to the homeowner. Ten questions are posed on some general information about the home followed by further questioning on inside the home, windows and doors, solar heating systems, walls, attics, foundations and basements, and other energy consumers for a total of 67 questions. The remaining appendices deal with information on processing the information supplied by the homeowner. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 57068, 57096, 57099, 57103, 57106, 57119

57083 **Energy: global prospects, 1985—2000.** Wilson, C.L. New York; McGraw-Hill Book Company (1977). 316p. $14.95.

Report of the workshop on Alternative Energy Strategies (WAES).

This book presents an extensive analysis of the world's energy prospects to the year 2000. An ad hoc, international project sponsored by the Massachusetts Institute of Technology, the workshop involved approximately 75 individuals from 15 countries. For more than two years they studied energy supply and demand for the rest of this century. Here are some of their major conclusions: (1) the supply of oil will cease to meet existing demand before the year 2000, most probably between 1985 and 1995; (2) demand for energy will continue to grow; this growth must increasingly be satisfied by energy resources other than oil; (3) the continued growth of energy demand requires that energy resources be developed with the utmost vigor; and (4) the critical interdependence of nations in the energy field requires an unprecedented degree of international collaboration in the future; in addition, it requires the will to mobilize finance, labor, research, and ingenuity with a common purpose never before attained in time of peace; and it requires it now. WAES was set up to provide a clear and consistent structure for national and international debate on energy strategies for the longer term. All of the energy sources were considered, and are discussed in this report: oil, coal, natural gas, nuclear fuel, solar, hydro, geothermal fusion, and other fossil fuels. The participants looked at national and international issues at the same time, in an integrated way, defining plausible future states of the world in which all nations must act. Then they asked how each individual nation will respond. Finally, they examined how these individual responses make up a global energy environment in which all nations must act. No previous forecasts have done this, nor have any looked as thoroughly at the 1985—2000 period when the real problems will appear.

57084 **Time of decision.** Rudolph, K.H. (Cleveland Electric Illuminating Co.). *Proc. Am. Power Conf.;* **39**: 3-8(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The United States, facing a deteriorating energy situation, is in the process of making decisions that could result either in a continuing downward slide or in effective programs to solve the energy problems. The author feels that investor-owned utility companies made progress in the financial area in 1976, but there remains a long way to go to reach the required strength. Prompt and adequate rate relief remains a "must." A sound financial base is important since indicators show demand for electric power to increase. The administration's energy policy is discussed, with conservation given top priority; alone, it cannot be the ultimate solution to the energy dilemma, the author says. Solar can represent only about 1% of the total installed power generation by the year 2000. The restraints on coal usage are reviewed. Delays on nuclear plants abound. The electric power industry will be affected by decisions made in all these areas. (MCW)

57085 **Prospects for World energy.** Abelson, P. (Carnegie Institution of Washington, DC). *Proc. Am. Power Conf.;* **39**: 34-40(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The United States was built on an economy based on cheap oil and natural gas. Cheap oil determined the mobile society, our agriculture, transportation system, and many other facets of our life styles. Around the world the various peoples adapted their economies to cheap petroleum. In the process, the use of other energy sources was curtailed, impeded, or eliminated. At the moment when the United States has used up most of its cheap energy sources, it and the rest of the world face enormous changes in their patterns of energy use and in their economies. One development that will certainly continue is the use of nuclear energy. Despite President Carter's moves with respect to the breeder reactor, other countries that are ahead of us will probably continue to develop and build them. After all, the breeder reactor is one possible long-term solution to the energy problem. Many countries, especially the less developed ones, have neither the money nor the technological capacity to build and operate nuclear stations. Some may be able to use energy from vegetation in the form of solid fuel, methane, or alcohol. Others have no excess biological materials, no technological capacity, and little financial resources. They will try to exist on a preindustrial $30 a year standard of living. In the worldwide adjustments that will be occurring, one of the inevitable features is going to be an expanded use of electric power. Many of the energy sources such as nuclear, solar, wind, and geothermal are most practically made available through electricity. Conservation is desirable but will not be enough, the author concludes. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 57061, 57067, 57099

57086 (CONF-7706130—, pp 16p, Session 1, Paper 4) **U.S. energy policy impact on the nuclear energy future.** Richards, R.B. (General Electric Co., Sunnyvale, CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The ultimate impact of the administration's energy policies on the future of nuclear energy can be assessed only when the energy outlooks of the nation and the world are examined well into the future. The assessment must include how energy is supplied and the required amount and cost as a function of time. The author briefly reviews the existence of slave labor in past centuries and says that energy is still produced by the muscle of human beings today. Expansion of energy supply to meet anticipated demand is investigated by using a "systems engineering" methodology. The development of a balanced energy policy involves identifying energy sources and bracketing demand forecasts. Four major criteria that must be dealt with in composing a balanced energy plan are the potential contribution, economics, environment, and political and institutional considerations. The author reviews all energy sources. Nuclear power has initially been played down by the Administration, but from the data presented in this evaluation matrix, perhaps Congress will restore nuclear power to its proper role in serving the nation's future energy needs. (MCW)

57087 (INIS-mf—4199, pp 98-142, 171-180) **Public involvement in danish energy policy. The nuclear power issue.** Refslund Poulsen, N.; Breinholt Larsen, F. 24 Oct 1977.

In Public involvement in Denmark.

57088 (NSF/RA—770213) **Energy policy making in the Northeast: a directory of state programs and institutions.** (Northeast Legislative Leaders Energy Project, Albany, NY (USA)). Sep 1977. 102p. Northeastern Legislative Leaders Energy Project, Albany, NY.

Energy problems are the most fundamental challenge facing the American political system; recent opinion polls, however, illustrate that the general public remains unaware of the nature and extent of the country's energy ills. The perception that energy-policy formulation and implementation is solely a matter for national governmental action and the complex character of existing governmental programs in the energy area may partially account for the general lack of public awareness. To help correct this confusion, the Northeastern Legislative Leaders Energy Project published this directory. The document should foster general recognition of the large role of state government in energy policymaking and clarify the "mild chaos" surrounding state energy policymaking by assembling a practical guide to energy responsibility within the ten Northeastern

states. It provides a "snapshot" of the current energy-related duties and programs of governmental institutions in the states of Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Legislative institutions along with executive bodies are included. State legislatures play a major and formidable role in solving pressing energy issues. Unfortunately, state legislative responsibilities and actions are often neglected in descriptions of energy policymaking.

57089 Research arms of Congress. *EPRI J.;* 3: No. 6, 16-21(1978).

Information and analyses of complex issues are largely provided to Congress from four legislative agencies: the Congressional Research Service, the General Accounting Office, the Office of Technology Assessment, and the Congressional Budget Office. The scope and functions of each are summarized, and it is noted that each of the four currently has an energy analysis group. These subgroups are described in terms of personnel and activities, which are not overlapping because of the different orientation of each group. A review of study topics requested by Congress indicates the major interest at present is solar technology, followed by a national electric grid, the siting and reliability of power plants, nuclear fuel reprocessing and waste disposal, energy supply issues, and renewable energy sources.

57090 Louis Austin: down-home realist. *EPRI J.;* 3: No. 6, 32-35(1978).

A profile of the Texas Utilities Company's chief executive portrays his philosophy that the environmental issues of energy technology can be resolved in an acceptable way through mediation. He criticizes overregulation and an overabundance of lawyers who are too interested in debating at the expense of finding solutions. He sees adversary proceedings as an inappropriate setting for making technical decisions. Pointing to the good surface mining land reclamation record of Texas Utilities, he protests environmental and economic policies that cause unwarranted delays and prevent energy development. Other targets are ivory tower and overlapping research efforts. He urges the Electric Power Research Institute (EPRI) to limit its research to work that isn't done by manufacturers and to work closely with the utilities to keep its research programs pertinent.

57091 Snail darter, snapdragon, saccharin syndrome: more power to whom. Bagge, C.E. (National Coal Association, Washington, DC). *Proc. Am. Power Conf.;* 39: 9-19(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Mr. Bagge cites and reviews the case of the snail darter halting the construction of a nearly-finished $200 million dam on the Little Tennessee River. Likewise, the Furbish Lousewort (a wild snapdragon) killed the Dickey-Lincoln project in Maine. He says the new class of environmentalists have raised their crusading to a professional level, because they have gained positions of power in government agencies. Citing his view that the coal industry wants power plants to convert to coal as rapidly as possible, the author thinks encouraging methods exist, moreso than compulsion. Easing air-quality requirements and Federal and tax incentives are mentioned. Four possible actions that might be used by members of the electric power industry to impact on the executive and legislative branches in Washington are discussed briefly. In conclusion, the author thinks the turning point may be an issue of saccharin—nothing to do with the environment. He believes the American populace will decide that they don't need laws and regulations to tell them whether saccharin is dangerous for consumption—it is needed for diet-conscious Americans. (MCW)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 57100

COAL

REFER ALSO TO CITATION(S) 56375, 56411, 56468

57092 How fast should coal be developed. Decker, G.L. (Dow Chemical Co., Midland, MI). *Proc. Am. Power Conf.;* 39: 20-25(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Coal must be developed at an optimum rate, according to Mr. Decker. If coal is developed too fast, there will be damage to the environment and—if it is developed too slowly—the nation will not be free of dependence on foreign energy supplies. The optimum must be determined by negotation between the pro-environment and pro-energy adversaries. The present situation cannot be allowed to continue he feels, for it will lead to social and economic disaster, or at the least, severe hardship. Part of the problem is that some segment of society finds objectionable features in just about every alternative proposal that has been put forth to alleviate the energy crisis. In examining the question of how fast it would be possible for the industry to develop coal, the problems are cited—environmental, social, and economic impacts. Mr. Decker thinks that technology exists to handle most of the problems. A program labeled the National Coal Policy Project was initiated to address those issues that seem to be most restrictive to development of coal resources. Participants from the environmental movement and representatives from industries consuming large quantities of energy met for the first time in July 1976.

PETROLEUM

REFER ALSO TO CITATION(S) 57067

57093 Natural resources in the oil and gas sector. Husain, A.R.M. (Ministry of Oil, Kuwait). *OAPEC News Bull.;* 4: No. 8, 9, 10-21(1978).

Presented to national seminar for application of science and technology, Kuwait Inst. for Scientific Research, May 6—7, 1978.

Total nationalization of Arab petroleum resources and refining operations and the assumption of price controls by the producing countries have brought new prosperity to the Organization of Arab Petroleum Exporting Countries (OAPEC). With the new wealth, the transition period from undeveloped to developed countries requires serious planning if the nations want to guarantee a comfortable life for future generations. The current situation is reviewed in terms of Kuwait's educational and technological policies aimed at developing an internal capability. Several conclusions and recommendations are made that will improve Kuwait's chances of meeting national goals. Full support of the Organization of Petroleum Exporting Countries (OPEC) organization is seen as vital to retaining a strong negotiating position.

57094 Evolution of OPEC strategy. Ghadar, F. Lexington, MA; Lexington Books (1977). 213p. $18.00.

This book is a study of the development and growth of national oil companies (NOCs) in oil-exporting developing nations. Case studies of Iran, Saudi Arabia, and Indonesia show that similarities exist in the development of these companies, making it possible to describe the development in three stages, between: (1) the local government and the foreign-owned enterprise; (2) the local government and the NOC, and (3) the foreign-owned enterprise and the NOC. The changing NOC ownership of oil facilities is discussed. From a sample of the ten largest OPEC producers' NOCs, it is concluded that the operations with the lowest barrier to entry into the petroleum industry were the first to be controlled by the NOCs. Within each nation the operations having the smallest scale and possessing the most readily available technology were the first activity undertaken by the NOCs. Conversely, operations with more sophisticated technology that demanded a larger scale for economic production and required foreign markets were controlled at a later date. Local marketing was the first operation taken over by NOC, followed by local refinery, and finally local production. Although it was established that the degree to which these three barriers to entry were present was detrimental to the NOCs undertaking and ownership of oil operations. Attempts to measure the relative importance of the erosion of these barriers were inconclusive. After looking at historical paths followed by the other companies with excess crude as they attempted to sell their crude in the multinational markets, the author projected the various probable paths that different NOCs will follow as they become multinational.

NATURAL GAS

REFER ALSO TO CITATION(S) 57067

HYDROGEN AND SYNTHETIC FUELS

57095 Energy solution in China. Smil, V. (Univ. of Manitoba, Winnipeg). *Environment;* 19: No. 7, 27-31(Oct 1977).

There is a way to considerably alleviate the real energy crisis--while at the same time protecting the environment, increasing crop yields, improving sanitation, and easing household work: biogas generation, a simple technology, appropriate for the developing nations. It utilizes organic wastes to produce, through anaerobic fermentation, a stable, nonpoisonous fuel of medium heat value (typically a mixture of 70% methane, 30% carbon dioxide, and traces of hydrogen, nitrogen, and hydrogen sulfide; caloric value is between 5,300 and 6,300 kilocalories per cubic meter, depending upon a number of factors) which can be used for cooking and lighting as well as for fueling farm machinery and for power generation. (Natural gas, used in gas ranges, has a heat value of 7,180

kilocalories per cubic meter.) Although the People's Republic of China is now self-sufficient in crude oil and ranks third in the world as a coal producer, commercial energy is not available readily or cheaply in many parts of the country, which still has inadequate transportation and a densely populated countryside. Recent large-scale adoption of biogas generation in China shows how much could be accomplished on a worldwide basis with a relatively simple and efficient technology utilizing abundant and, what is most important, renewable local resources. The design of a successful water-pressurized tank consisting of loading, fermentation, and sludge chambers is described. The benefits of biogas utilization are summarized. (MCW)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 56698, 56699, 56882, 56883, 56935, 57084, 57131

57096 (CONF-7706130—, pp 10p, Session 1, Paper 5) **Utilities viewpoint of the long-term energy options.** Kearney, J.J. (Edison Electric Inst., New York). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

Some background material on electric power growth is presented; resource and generating options available to the electric utility industry to serve increased demands are discussed; and the impact of President Carter's proposed energy policy on these options is surveyed. The author concludes that the policy impact on the utility industry's options for future power generation is significant. It does not encourage energy-supply initiatives nor provide for a rational balance between environment goals and energy requirements. The industry hopes that legislative measures of the proposals will bring modifications that will ensure the use of coal and nuclear power for an electric future. (MCW)

57097 (MTR—7485(Vol.4)) **Systems descriptions and engineering costs for solar-related technologies. Volume IV. Conventional technologies for electric utility applications.** Miller, G. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1977. Contract EX-76-C-01-2322. 101p. Dep. NTIS, PC A06/MF A01.

This document presents engineering costs and system performance for competitive fossil- and nuclear-fueled generation technologies. The data are developed to provide a data base for predicting future market penetration of solar technologies. To provide an accurate and consistent basis for market penetration analyses, the work reported in this volume was based on a set of assumptions common to all volumes and use of methodology consistent with that used for solar technologies. Competitive fossil- and nuclear-fueled generation technologies include those technologies expected to be most competitive between 1980 and 2020. On the basis of choosing a wide variety of technology types and of choosing those technologies exhibiting relatively competitive costs, eight technologies were chosen and are discussed: conventional coal/steam with flue gas desulfurization; open-cycle gas turbine/steam turbine with integrated coal gasification; atmospheric fluidized bed; light water reactor; liquid metal fast breeder reactor; open-cycle gas turbine with recuperator; open-cycle gas turbine-combined cycle; liquid metal fast breeder reactor and coal steam plant incorporating thermal oil storage. Most of the technologies are expected to have demonstrations completed by 1990. The LMFBR and thermal oil storage are expected to have been demonstrated shortly after 1990. Generally the dates for demonstration represent optimistic estimates of the earliest timeframe within which prototype units could be completed. Sections 8 and 9 discuss the availability and anticipated costs of coal and nuclear fuels, respectively. (MCW)

57098 (TID—28123) **National Electric Rate Book. Georgia.** (Federal Power Commission, Washington, DC (USA)). Aug 1977. 21p. Dep. NTIS, MF A01.

Rate schedules for electric service in communities of 2,500 population or more: residential, commercial, and industrial services. Portions of document are illegible.

57099 **Electricity future: what can you believe.** Starr, C. (Electric Power Research Inst., Palo Alto, CA). *EPRI J.;* **3**: No. 6, 28-31(1978).

Because no single best energy policy can emerge from the many uncertainties surrounding energy technology for the future, responsible leadership dictates that proven energy sources be expanded while all potential sources are pursued. Near-term efforts to reduce dependence on imported oil must be consistent with the policies affecting the discovery and use of new oil and uranium reserves. The author reviews electricity demand projections with present generating capabilities and the range of options for the future as they relate to the required societal and technical lead time. Doomsday predictions have a poor record and can confuse energy policymakers. Energy efficiency can save as much as 20% of future energy-supply needs, but present supply sources must expand for the immediate future and advanced technologies must be developed in an environment of cooperation rather than confusion and distrust.

57100 **Economics of coal and nuclear electricity: a treatment of inflation and differential cost increases.** Phung, D.L.; Perry, A.M.; Whittle, C.E. (Oak Ridge Associated Universities, TN). *Proc. Am. Power Conf.;* **39**: 407-415(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The cost competitiveness between the coal and nuclear options depends on location, capital requirement, fuel supply, and environmental and safety regulations. The authors present a formulation that permits rational treatment of inflation and differential fuel cost increases. They also examined many likely scenarios that reflect the great uncertainty confronting the utility executive. Unless nuclear fuel will increase at 4 percent per year over and above increases in coal cost, or unless nuclear plants cost much more and deliver much less energy than realistically projected, the authors conclude that nuclear electricity is the economic choice for most parts of the country except in the Western coal region. In this region, coal electricity is cheaper due to low transportation cost; but if coal-fired plants in this region are also required to install SO_2 scrubbers, the competition against nuclear electricity would follow the same pattern as in other regions. The authors further conclude that, due to institutional constraints, inflation tends to favor the high-capital, low-fuel-cost power option. (MCW)

57101 **Load forecasting in today's environment.** McMahon, J.A.; Maxwell, L.C. (Tennessee Valley Authority, Chattanooga). *Proc. Am. Power Conf.;* **39**: 993-998(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

This paper examines the basic influences on load growth and alternative methodologies which can be used to quantify these influences, using specifically, experiences at the Tennessee Valley Authority. The TVA approach to load forecasting is designed mainly to explain four broad influences on load growth—economic activity, conservation, substitution of electricity for scarce fossil fuels, and increased use of electricity for pollution abatement in industry. TVA utilizes different methodological approaches in forecasting in order to quantify the four factors influencing load growth. These methodologies include trend forecasts, engineering models, and econometric models. These methods are combined with various sources of information including discussions with customers, surveys of pollution abatement and substitution, and forecasters' judgment in order to derive a forecast of electricity consumption. (MCW)

57102 **Reliability and adequacy of North American electric bulk power supply.** Wolters, K.E. (Wisconsin Electric Power Co., Milwaukee). *Proc. Am. Power Conf.;* **39**: 1090-1097(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The National Electric Reliability Council's objective is to augment the adequacy and reliability of electric bulk power supply in North America. In a 1975 review, NERC determined that the major problems threatening future electric supply were: lack of national commitment to energy objectives; uncertainty about future fuel sources; conflicting governmental regulations; proliferation of licensing and siting procedures; and financial constraints and lack of timely rate relief. NERC urged speeding resolution to these problems "to avoid a crisis in the not-too-distant future which will lead to a period of electric energy shortages of increasing magnitude." Then in its 1976 review, NERC determined ". . . that very little, if any, progress has been made to resolve these issues and, therefore, there is now greater concern regarding the future adequacy and reliability of the nation's electric power supply." The 1977 review had not been released at the time of this presentation, but it was felt the same statement would apply. The author concludes that it is both significant and of extreme concern that many constraints to future adequacy and reliability have developed as a result of past legislative action or governmental decisions and can be relieved only by other legislative action or governmental decision. (MCW)

ELECTRIC POWER GENERATION

57103 (CONF-7706130—, pp 9p, Session 3, Paper 2) **Conservation, load growth, and alternative-generation concepts.** Looney, Q. (Electric Power Research Inst., Palo Alto, CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The U.S. energy situation can be described in terms of three major, related characteristics: long-term, serious, and complicated. It is the third, complexity of the problem, that makes a solution virtually impossible. Supplies and needs for energy vary widely with

geographical region, type of user, and time of year. EPRI is working on developing "preferred systems" to help mitigate potential problems with emerging energy-conservation technologies. The status of these projects and the rapidity with which important factors are changing make it difficult to justify any quantitative estimates on the impacts of energy conservation on load growth at this time, the author says. He first reviews the time scales involved and the criteria to be satisfied before a new generation option can be expected to contribute significantly to national electricity production. In this paper the specific new energy options under investigation for generating electricity or for reducing the need for it are tabulated, but were discussed in length at the meeting. Incentives, objectives, and projects for year 2000 are characterized for LMFBR, geothermal, solar, nuclear fusion, wind power, ocean thermal energy conversion, biomass, synthetic fuels, fuel cells, energy storage, and energy management. (MCW)

57104 Small hydro sets can yield competitive energy. Gordon, J.L. (Montreal Engineering Co.). *Energy Int.;* **15**: No. 8, 26-29(Aug 1978).

Small hydro sites are becoming more attractive as fuel prices rise and major hydro sites are taken. Studies in several countries show a potential for non-hydro power dams, and manufacturers are evaluating and developing cost-effective small-package equipment for them. Short cuts for evaluating the costs of a small hydro plant are outlined and shown to have a relatively expensive initial cost, with lower life-time costs. The author illustrates how to estimate and rank sites according to costs.

57105 Adding financial simulation to long-range generation planning. Felak, R.P.; Marsh, W.D.; Moisan, R.W.; Sigley, R.M. (General Electric Co., Schenectady, NY). *Proc. Am. Power Conf.;* **39**: 999-1009(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

An integrated approach to electric utility generation planning is developed in this paper. As discussed, financial simulation complements the conventional total-system concept of generation system reliability, operations, and investment costing in the appraisal of alternate-generation expansion decisions. An example study illustrates that, while two alternate plans are equal in terms of present worth of all revenue requirements, the results of the financial simulation may show differences that are significant to electric utility decision makers. In conclusion, this paper presents a planning approach that provides a thorough review of the reliability, operations, and financial implications for generation expansion plans over the long-range planning periods required to evaluate these decisions.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 56966

57106 Electrical loads can be forecasted for distribution planning. Menge, E.E.; Wilreker, V.F.; Northcote-Green, J.E.D. (Westinghouse Electric Corp., Pittsburgh). *Proc. Am. Power Conf.;* **39**: 1155-1162(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Accurate forecasts of electrical demand in small geographic areas are needed if a utility is to develop comprehensive plans for expanding its transmission and distribution systems. The limiting item in using optimization methods is the value to be used for future small-area demands. This paper describes two techniques for developing small-area demand forecasts that show considerable improvement over existing techniques. The first technique, time-series trend analysis, describes small-area demand as a time function based solely on historical data. Forecasts are obtained from projections of the historical trend. The second technique, multivariate spatial analysis, describes small-area demands as a function of both historical data and correlative variables. Forecasts are derived from estimates of future values for the appropriate correlative variables.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 57076, 57079, 57119

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 56869, 57062

57107 (CONF-7706130—, pp 59p, Session 4, Paper 1) **Timing and selection of the inexhaustible energy sources.** Hirsch, R.L. 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

This general discussion covers the status, advantages and disadvantages of alternate energy sources, and the outlook for solar, fusion, and breeders. A proposed national approach is given for the development and deployment of the inexhaustibles. (MOW)

SOLAR

REFER ALSO TO CITATION(S) 56697, 56698, 56699, 56706, 56709, 56714, 56716, 56719, 56729, 56732, 56736, 57078, 57097

57108 (HCP/M5037—01) **Options for passive energy conservation in site design.** (Center for Landscape Architectural Education and Research, Reston, VA (USA); Reimann-Buechner-Crandall Partnership, Syracuse, NY (USA)). Jun 1978. Contract EC-77-C-01-5037. 232p. Dep. NTIS, PC A11/MF A01.

At a time of concern for energy supplies and costs it is essential to examine the energy-conserving potential of once again using natural energy systems and patterns that exist on any site on which a building is to be or has been placed. This state-of-the-art study examines existing research and applications of land planning and design for energy-conservation purposes. It is organized around the basic principles of natural heating and cooling factors and the impact of site elements on human comfort, regional adaptation of these principles, steps in the site planning and design process, and energy-conservation options available in each of the steps. This is supplemented by an appendix and a bibliography of additional references. The principles of site planning and design for energy conservation deal with the impact of the sun and wind on natural elements and, conversely, ways in which landforms, water, and vegetation affect the impact of the sun and wind on limited sections of the earth. For instance, the sun is able to naturally warm certain slopes more than others, certain surface materials naturally accentuate the warmth of the sun, while certain naturally occurring elements, such as vegetation, block and control the sun. The wind moving over the earth's surface has certain natural directions, patterns, and characteristics. By recognizing these and by introducing or removing impediments it is possible to modify these patterns to provide natural ventilation and to conserve energy. Four commonly accepted regional divisions were utilized to illustrate the differing applications of these principles in the temperate, hot-humid, hot-arid, and cool regions of the continental U.S. The typical site planning or design process was superimposed over each region to illustrate the various energy conservation options possible, depending upon the precise decision made in each step in each region. 300 references.

OTHER

REFER ALSO TO CITATION(S) 56703, 57095

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 56710

57109 Open-cycle MHD energy conversion: prospects and developments for central-station power generation. Hals, F.; Petty, S.; Stickler, D.; Solbes, A. (Avco Everett Research Lab., Inc., MS). *Proc. Am. Power Conf.;* **39**: 651-663(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The technology status and development program for MHD power generation is described. The conservational and environmental benefits offered by MHD for large-scale electrical power generation with more efficient use of coal and with less environmental intrusion including reduction of air pollutants to well below EPA standards have been substantiated in the recent Government-sponsored ECAS study. Significant progress has been achieved in the development of open-cycle MHD, including the testing of an experimental MHD generator under conditions which realistically simulate those of projected full-scale coal-burning MHD generators for central station power plant applications. The initial conceptual design phase of an ETF for pilot-scale testing of a coal-burning integrated MHD steam power system has commenced. This will provide the engineering base for a subsequent commercial-sized demonstration plant. The development of MHD involves risks. The prospective important social and economic benefits warrant an aggressive development program.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 57109

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 57109

DUCT ENGINEERING AND FLUID DYNAMICS

57110 (FE—2341-5) **High magnetic field MHD generator program. Quarterly report, October—December 1977.** Eustis, R.H.; Kruger, C.H.; Mitchner, M.; Self, S.A.; Koester, J.K. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Mar 1978. Contract EX-76-C-01-2341. 36p. Dep. NTIS, PC A03/MF A01.

Predictions were made for the results anticipated from an experiment scheduled for April which will investigate fluctuations of thermodynamic and electrical properties as a function of generator configuration and operating conditions. Further work on the laser fluorescence technique has shown it to be promising for the non-obtrusive spatial resolution of gas temperature. Reduction of data from an earlier electrode boundary layer experiment resulted in temperature profiles which showed the effect of Joule heating. Measurements also showed the electron number density near the electrode to be out of equilibrium due to finite electron recombination rates and to Joule heating. Thermal tests continued with the 6 tesla disk generator to determine the most favorable peg size and attachment technique to handle the large thermal load in the disk channel. The major design decisions for the 6 tesla linear generator have been made.

57111 **Experimental thermionic emission characteristics of seeded coal-slags under simulated magnetohydrodynamic conditions.** Petersen, C.K. Salt Lake City; Univ. of Utah (1978). 57p. University Microfilms Order No. 78-08,316.

Thesis (Ph. D.).

A coal-fired MHD duct atmosphere simulation system has been built and tested to observe the emission characteristics of various seeded coal slags. It was found that cathode arcing severely limits the emission from seeded coal slag below 1.0 A/cm^2. Transition current densities, for thermionic to arcing emission, were observed from approximately 10^{-2} A/cm^2 at 1375°C to 0.5 A/cm^2 at 1720°C. That is, if a transition current is exceeded, arcs form on the cathode surface. It was also shown experimentally that at temperatures below 1720°C, large voltages of approximately 100 to 500 volts were required to draw even moderate currents of 0.100 A/cm^2. The temperature at which the emission characteristics were investigated was 1320 to 1720°C.

57112 **MHD generator with improved network coupling electrodes to a load.** Rosa, R.J. (to Energy Research and Development Administration). US Patent 4,047,094. 6 Sep 1977. Filed date 22 Jul 1976. 10p.

PAT-APPL-707,925.

An MHD generator has a plurality of segmented electrodes extending longitudinally of a duct, whereby progressively increasing high DC voltages are derived from a set of cathode electrodes and progressively increasing low DC voltages are derived from a set of anode electrodes. First and second load terminals are respectively connected to the cathode and anode electrodes by separate coupling networks, each of which includes a number of SCR's and a number of diode rectifiers.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 56675

THERMIONIC CONVERTERS

PERFORMANCE AND TESTING

57113 **Electric characteristics of a low-temperature thermionic converter.** Menabde, N.E.; Tskhakaya, V.K.; Tsakadze, L.M.; Yur'ev, V.A.; Lebedev, V.N. (Sukhumi Physicotechnical Institute). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 108-109(Jan 1978).

The current-voltage characteristics as well as specific electric power output were measured for a thermionic converter with w emitters and Ni and Mo collectors. (AIP)

MATERIALS, COMPONENTS, AND AUXILIARIES

57114 **Auxiliary discharge in a thermionic converter.** Kaibyshev, V.Z.; Karetnikov, D.V.; Trutnev, A.L. *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 17-21(Jan 1978).

The voltage drop in the low-voltage arc of a cesium thermionic converter is about 0.5 V under optimum conditions. Experiments show that it is possible to reduce this drop by means of an auxiliary inert-gas discharge. The optimum parameters of the auxiliary emitter and of the auxiliary discharge is very sensitive to the electrode work function. The required emitter work function can be achieved by adding barium vapor at a low pressure so that the barium does not affect the discharge parameters. A simple physical model leads to a good qualitative agreement with experiment. There is a fundamental limit on the parameters of a converter with an auxiliary discharge.

FUEL CELLS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 57115

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 57497

57115 (FCR—0720) **Improvement of fuel cell technology base. Technical progess report No. 1, 1 October—31 December 1977.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 30 Jan 1978. Contract EY-76-C-03-1169. 29p. Dep. NTIS, PC A03/MF A01.

The principal objective of this program is to identify improvements in phosphoric acid cell technology and power plant design which, if developed, would permit construction of a power plant equivalent to the 4.8-MW Demonstrator but lower in both manufacturing and operating cost. Such improvements will also lead toward increased endurance capability. The design and endurance testing of several test cells are described.

MATERIALS, COMPONENTS, AND AUXILIARIES

57116 **Fuel cell electrode.** Baris, J.M.; Iacovangelo, C.D. (to United Technologies Corporation). US Patent 4,058,482. 15 Nov 1977. Filed date 20 Dec 1976. 6p.

A sheet material, principally comprised of a polymer such as polytetrafluoroethylene, having characteristics which permit its use in a fuel cell electrode is formed from co-agglomerates of the polymer and a pore former. In a fuel cell electrode application, the polymer-pore former agglomerates are themselves caused to co-agglomerate with a catalyst, the resulting co-agglomerates are formed into a layer and the pore former is leached from the layer so as to produce a structure having gas channels only in the polymer portions thereof. Agglomeration of the pore former and polymer particles is permitted through first imparting a positive charge to the pore former particles. The gas permeable catalyst layer will be bonded to a support plate to define a fuel cell electrode.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

BUILDINGS

REFER ALSO TO CITATION(S) 57108

57117 (AD-A—051074) **Fixed facilities energy consumption investigation initial energy data. Interim report.** Windingland, L.M.; Sliwinski, B.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jan 1978. 97p. (CERL-IR-E—120). NTIS PC A05/MF A01.

This report describes energy consumption data obtained between December 1976 and March 1977 for 45 Army buildings being monitored at Fort Belvoir, VA, Fort Carson, CO, and Fort Hood, TX, as part of a study being conducted to identify energy consumption patterns at fixed Army facilities. The 45 buildings represent six of the major energy consumer groups found on Army installations: family housing, troop housing, administration/training buildings, production/maintenance buildings, medical/dental buidlings, and community support facilities. This report provides potential users of energy data with preliminary findings and indicates the formats and analysis techniques which will be used in a full-year energy-consumption data report to be published in FY78. Consumption data for electrical energy and fossil fuels are presented as monthly energy-consumption totals for the six energy consumer groups. The electrical data for each building are analyzed by computing the daily usage per unit area. The heating energy use for various buildings is compared by computing the energy used per unit area per heating-

degree day. Typical daily and monthly usage profiles are presented for each energy consumer group. (Author)

57118 (BNL—50862) **Assessment of thermal insulation materials and systems for building applications.** (Brookhaven National Lab., Upton, NY (USA); Dynatech R/D Co., Cambridge, MA (USA)). Jun 1978. Contract EY-76-C-02-0016. 299p. Dep. NTIS, PC A13/MF A01.

The primary goal of the study was to provide a proper foundation for decision making by the federal government, industry, and consumer. The report may be used to identify areas where new test methods and standards are needed to establish new programs for improving thermal performance of buildings, and as a basis for setting new or improved standards after the recommended test programs have been completed.

57119 (CONF-780802—4) **Conditional rate structures: a unique statistical approach to energy use assessment and confidence intervals.** Liepins, G.E. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Statistical Association meeting; San Diego, CA, USA (14 Aug 1978).

Portions of document are illegible.

A unique statistical approach to the problem of estimating residential energy use is presented. Such estimates have historically been based on ad hoc methods without a solid theoretical infrastructure, and as a consequence, the results have been difficult to quantitatively evaluate. As a first step in rectifying these shortcomings, a constructive proof is given of a consistent estimator and confidence levels for the estimate are derived. In particular, it is shown that the appropriate rate structure to use to impute actual energy use from expenditure figures is the average rate structures weighted by the conditional probabilities at each expenditure level. Associated with the Cartesian product space of rate structures by expenditure levels is a path space which leads to the appropriate formulation of confidence levels.

57120 (NTIS/PS—78/0165) **Heat pumps (citations from the NTIS data base). Report for 1964—January 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 99p. NTIS PC N01/MF N01.

Technical and economic feasibility of extracting heat from one temperature source and delivering the thermal energy extracted for use at a higher temperature is discussed in abstracts of Federally-sponsored research. Air to air, air to water, and water to water heat pump systems are covered with reference to residential, commercial, and industrial applications. Performance and reliability studies of heat pumps, including solar assisted heat pumps, for residential heating are emphasized. (Contains 94 abstracts)

57121 (NTIS/PS—78/0166) **Heat pumps (citations from the Engineering Index Data base). Report for 1970—January 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 249p. NTIS PC N01/MF N01.

Design, performance, and applications of heat pumps are discussed in abstracts from worldwide literature. The heat pumps, which extract heat from one temperature source and deliver the extracted heat for use at a higher temperature, are discussed with regard to their energy conserving potential in residential, commercial, and industrial applications. Air to air, air to water, and water to water heat pump systems are covered. The use of heat pumps, including solar assisted heat pumps, in heating and cooling of buildings and heating of swimming pools is emphasized. (Contains 242 abstracts)

57122 Thermal insulation demonstration device. Fisher, T. US Patent 4,095,454. 20 Jun 1978. Filed date 31 May 1977. 6p.

A device for demonstrating the relative effectiveness of various types of thermal insulation is described. The device has a plenum chamber, at least two cells each communicating with the plenum chamber and receiving a quantity of insulation therein, and a separate after chamber communicating with each cell and the atmosphere with a thermometer received therein. A portion of a stream of heated air under pressure discharged into the plenum chamber passes through each cell and its associated after chamber and is discharged into the atmosphere. The differences in the temperature, as indicated by the thermometers, of the stream of air passing through each after chamber provide a visual indication of the relative effectiveness of the insulation in each cell and such differences in temperature can be physically sensed by a person who successively places a hand in the stream of air discharged to the atmosphere from each after chamber.

57123 TVA's experience and work with the electric heat pump. Carver, G.D. (Tennessee Valley Authority, Chattanooga). *Proc. Am. Power Conf.;* **39**: 789-793(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

TVA's experience with promoting electric heat pumps as an energy conserving means for space conditioning buildings is related. In the early 1950's there were so many compressor failures and service problems, that heat pumps were avoided. Design research by manufacturers and the development of TVA's Certified Electric Heat Pump Installation Program helped reverse this attitude. In 1977, 80,000 heat pumps serve consumers in the TVA area saving about 560 million KWh or 268,000 tons of coal annually. Further increases in the use of residential heat pumps are expected. (LCL)

57124 Unitary heat pump industry: 1952 to 1977. Pietsch, J.A. (General Electric Co., Tyler, TX). *Proc. Am. Power Conf.;* **39**: 816-821(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The history of the development of unitary heat pumps from the discovery in 1850 of its operating principle to the present is reviewed. In the last 25 years difficulties with the reliability and performance of heat pumps were overcome. It is predicted that in the next 25 years the heat pump will become the dominant confort heating system. (LCL)

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 57081, 57082

57125 Heat requirements and energy use in British houses. Heap, R.D. (Electricity Council Research Centre, Chester, Eng.). *Energy Build.;* **1**: No. 4, 347-366(Jun 1978).

Housing data and likely ranges of insulation levels are combined to give estimates of the heating requirements for conventional houses and small flats to be built in Britain in 1977-1987. After allowance for non-solar heat gains, requirements of 65 to 120 kWh/day for 4 to 6 person houses and of 8 to 47 kWh/day for small flats are predicted. The 65 kWh/day lower limit for houses will be improved on in the case of very well insulated houses using modified construction techniques. Data are collated showing average incidental heat gains from appliances, water heating, and other sources. The effects of these on annual heating energy use and on mean power requirements are assessed, and annual heating energy use per kW of design heat loss is calculated for a range of levels of incidental gains at three British locations: Pembroke, Croydon and Edinburgh. The typical solar contribution to this heating energy is also calculated. Mean-to-peak power variations are considered, showing that on average a heating system operates at 20 to 30 percent of the house design heat loss; this is the level at which energy use efficiency is most significant. The theoretical predictions of heating energy use are shown to give reasonable agreement with actual use as measured in field trials, despite the wide variability of the latter. The variation of total solar heating with orientation of a house with windows on two opposite sides is studied in the Appendix, showing a variation of +-15 percent in winter and +-6 percent in spring and summer for a particular house design.

57126 New fenestration material for heat protection. Varshneya, N.C. (Univ. of Roorkee, India); Verma, V.V. *Energy Build.;* **1**: No. 4, 383-391(Jun 1978).

This work applies the Mie scattering theory to the case of polydisperse spherical air bubbles embedded in a transparent medium. It calculates the attenuation through such medium of normally incident solar radiation. The attenuation depends on the size parameter, x; where x is 2/sup pi/ times the ratio of bubble radius to the incident wavelength. By proper choice of the bubble size the attenuation can be made skew with respect to the wavelengths of incident solar radiation. A practical application of this theory has been made in the design of fenestration material. The bubble size can be so chosen as to attenuate the larger wavelengths considerably more than the shorter ones. This will suit the fenestration requirements of the tropical climate, insofar as the elimination of heat is desirable. A fenestration material (a Perspex sheet with air bubbles embedded in it) based on these considerations has been prepared and attenuation of normally incident radiation from an artificial source, simulating solar radiation, through it has been measured experimentally. The results are in good agreement with the theoretical calculations obtained for such case. The cut-off is about 14 percent.

57127 Residential water heaters: energy and cost analysis. Hirst, E.; Hoskins, R.A. (Oak Ridge National Lab., TN). *Energy Build.;* **1**: No. 4, 393-400(Jun 1978).

A detailed computer model is developed to calculate energy flows for residential electric and gas water heaters. Model equations are derived from applications of the first law of thermodynamics, analysis of manufacturers' literature, and related studies. Several energy-saving changes are examined using the model. Changes for both electric and gas water heaters are: increase jacket insulation thickness, reduce jacket insulation thermal conductivity, reduce

thermostat setting, and add insulation to the distribution line. Application of all these changes to an electric water heater would reduce electricity use 17 percent and increase initial cost 27 percent. Additional changes examined for gas water heaters are: reduce pilot rate, eliminate pilot and add electric ignitor and flue closure, and reduce excess air for combustion by increasing flue baffling. Implementing all these changes to a gas water heater (except addition of electric ignitor) would reduce gas use 27 percent and increase initial cost 26 percent. These results show that there are large opportunities for reducing water heater energy use with only small initial cost increases.

57128 Large size refrigerator-freezer with cycle defrost refrigerator. Onishi, T.; Niida, H.; Tsutsumi, M. *Toshiba Rev., Int. Ed.;* No. 115, 32-36(1978).

Home use electrical refrigerator-freezers are classified into two general categories, involving: direct cooling system and indirect cooling system units. The direct cooling system has favorable cooling characteristics for home appliances with a low electrical power consumption advantage. In the direct cooling system refrigerator-freezer, two compartment temperatures are interrelated to each other, but are controlled separately. However, cooling balance between two compartments is difficult to attain in a larger than 300 l volume unit, thereby making it also difficult to attain desired equivalent performance under some certain conditions. Therefore, conventional units have adopted a two-compressor system that enables independent cooling cycles or completely indirect cooling system. Controlling technologies were developed whereby, though still adopting direct cooling system and using a single compressor, temperatures are independently controlled. The unit design is such that direct cooling unit capacity increase is made, while maintaining cooling performance equivalent to those of indirect cooling system units. The direct cooling system large capacity refrigerator-freezer and its temperature controlling features are discussed.

57129 Thermoelectric heat pump for residental heating and cooling. Lavan, Z. (IIT Research Inst., Chicago); Budenholzer, R.A.; Fieldhouse, I.B.; Mathiprakasam, B. *Proc. Am. Power Conf.;* **39**: 805-815(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A thermoelectric heat pump system is composed of many thermocouples each of which has a capacity for pumping heat of about 4 to 12 Btu/h. A successful submarine air conditioning system with 2280 thermocouple junctions has been built. The theoreticai basis for thermoelectric heat pumps, thermoelectric properties of bismuth telluride-bismuth selenide junctions, operation and performance of such heat pumps with and without solar assistance, and the advantages of the thermoelectric heat pump over the vapor compression heat pump are discussed. (LCL)

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 57080

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 56779

57130 (AD-A—049488) **Installation energy control system analysis program. Final report.** Hollis, H.D.; Kukielka, C.A.; Baum, P.E. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Research and Technology Div.). 1 Jun 1977. 85p. (USA-FESA-RT—2033). NTIS PC A05/MF A01.

The Installation Energy Control System Analysis Program uses previously developed methods, to estimate the cost and savings of an energy control system. The program uses the guidance found in AR-11-28 to calculate the present worth of options analyzed and compares them against the baseline where no system has been employed, i.e., no savings. Simple payback is also calculated using the Energy Conservation Investment Program (ECIP) guidance. The meaning of the input data, how the program is exercised, and the interpretation of the output are discribed. The appendices contains input forms, a source listing of the program, and a sample program output.

57131 (AD-A—049877) **Costs and benefits of extensive electricity metering at the Naval Postgraduate School, Monterey. Master's thesis.** Walton, D.L. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1977. 48p. NTIS PC A03/MF A01.

A brief history of utilities conservation and background on electricity metering in the Navy are discussed. A cost analysis was made of the savings that would be required to justify installation of meters in the operational area of the Naval Postgraduate School, Monterey, California, using net present value techniques. Cost data from a metering project at Pacific Missile Test Center, Pt. Mugu, California forms a basis for this analysis. The analysis indicates that meters would be justified at the school if an annual savings of electricity resulting from metering could be realized in the range of 2.1% to 7.4%. It is concluded that similar analyses should be conducted at other Navy installations to determine the amount of electricity savings that would be required to justify metering.

57132 Energy efficiency at the Ohio State University. Fuller, R.H.; Sullivan, D. (Ohio State Univ., Columbus). *Energy Build.;* **1**: No. 4, 401-413(Jun 1978).

The Ohio State University is actively engaged in an energy conservation program, the results of which are surpassing the energy savings anticipated when the program originated. The goal stated in the original proposal was to obtain a 20 percent average energy reduction in buildings analyzed. The estimated dollar reduction in utility costs on over 50 buildings now studied range from 30 to 60 percent. Actual metered results on several buildings already modified show that the estimated savings are usually conservative.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 57080

57133 (NTIS/PS—78/0305) **Total energy systems for buildings (citations from the NTIS data base). Report for 1964—March 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 155p.

Technology and economics associated with total energy systems are discussed in these Federally-funded research citations. These systems employ a primary source of energy, such as oil, natural gas, or solar heat to provide comprehensive energy requirements in the form of light, heating, cooling, air conditioning, drying, process heat, and power for an industrial plant or for a commercial or public building. Included are schemes for electricity generation, waste heat recovery, and direct power drive of mechanical equipment coupled to a prime mover. Abstracts primarily pertain to Modular Integrated Utility Systems (MIUS) technology as applied to residential complexes; a few abstracts deal with MIUS technology for military facilities and commercial buildings. Topic areas cover social costs, energy conservation potential, and the use of solar energy in total energy systems. (This updated bibliography contains 150 abstracts, 39 of which are new entries to the previous edition.)

57134 (NTIS/PS—78/0306) **Total energy systems for buildings (citations from the Engineering Index data base). Report for 1964—March 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 72p.

Technology for total energy systems as applied to residential complexes and industrial plants is discussed in these citations from worldwide research. These systems employ a primary source of energy, such as oil, natural gas, or solar heat to provide comprehensive energy requirements in the form of light, heating, cooling, air conditioning, drying, process heat, and power for an industrial plant or for a commercial or public building. Included are schemes for electricity generation, waste heat recovery, and direct power drive of mechanical equipment coupled to a prime mover. Modular Integrated Utility Systems (MIUS) are covered, including studies on gas turbines for use in MIUS systems, and computerized simulation studies. (This updated bibliography contains 65 abstracts, 4 of which are new entries to the previous edition.)

TRANSPORTATION

REFER ALSO TO CITATION(S) 57076

57135 (HCP/W4248—) **Passenger car fuel economy in short trip operation. Alternative fuels utilization program.** (Gulf Research and Development Co., Pittsburgh, PA (USA)). Jul 1978. Contract EC-77-C-02-4248. 66p. (P). Dep. NTIS, PC A04/MF A01.

This project was initiated to assess the benefits that could be attained from a gasoline blended to provide improved short trip fuel economy. It was approached with two goals in mind. First, develop a test procedure to effectively evaluate any method that shows promise for improved fuel utilization. Second, use the procedure to obtain a better understanding of what is needed in present day gasoline to improve short trip economy. An all-weather chassis dynamometer with precise temperature control was used for this project. Th factorial test design was used to compare typical seasonal fuels with a special fuel developed to better establish the effect of fuel gravity on fuel economy. Two operating temperatures, 0°F and 90°F, were used in the program. The fuel effect was evaluated in small cars and in large cars and with standard carburetion and fuel injection. The four cars used in the program were a Cadillac Seville with fuel injection, an Oldsmobile Delta 88 with carburetion, a Volvo 245 DL with fuel injection, and a Ford Pinto with carburetion. Five of the analysis of variance programs were used for the

evaluation of the data from the three stages of the program. The fuel effects are presented in detail and they show that whenever it is possible to detect a significant difference between fuel, the special fuel developed for this program gives improved fuel economy. The high levels of significance of 99% or more obtained in the analysis of variance support the accuracy of the test procedure. The test results are effective in showing that some cars are much more efficient in short trip operation than others.

57136 (PB—276560) **Forecast of developments in domestic minerals transport. Final report.** Weinblatt, H.; Matzzie, D. (CONSAD Research Corp., Pittsburgh, PA (USA)). Nov 1977. Contract J0166002. 230p. NTIS PC A11/MF A01.

A study was undertaken of the current situation and prospective developments in domestic transport of nonenergy minerals. The four major modes of transport were covered: railroad, highway, water, and pipeline. In the first phase of the study, a metal (copper) and a nonmetal (phosphate rock) were selected and studied in depth. Various problems facing shippers and carriers of these minerals were identified. The second phase of the study expanded the scope to all nonenergy minerals and qualitatively forecast developments into the future. Estimates of increased fuel prices for each mode of transport were applied to assess expected changes in transport cost and modal competition. For some of the key issues facing domestic transport of minerals, possible actions for the Bureau of Mines include further analysis to identify the impact of policy options.

AIR AND AEROSPACE

57137 (CONS—1011-19) **Degree of vaporization using an airblast type injector for a premixed-prevaporized combustor.** Tacina, R.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1978. Contract EC-77-A-31-1011. 11p. (CONF-780820—1; NASA-TM—78836). Dep. NTIS, PC A02/MF A01.

From 1. conference on liquid atomization and spray systems; Tokyo, Japan (28 Aug 1978).

Vaporization data that could be useful in designing premixed-prevaporized fuel preparation systems for gas turbine combustors are presented. The effect of the experimental parameters on vaporization was found to be E = T/sub in/ tau$^{0.18}$(V/sub ref/ + 38) (P/sub in/ + 35)/ 203000 where E is the degree of vaporization in percent, T/sub in/ the inlet air temperature in K over the range 450 to 700 K, the residence time in ms over the range 4.3 to 23.8 ms, V/sub ref/ the reference velocity in m/s over the range 5 to 22 m/s, and P/sub in/ in the inlet pressure in MPa over the range 0.18 to 0.59MPa. Jet A and Diesel no. 2 fuels were tested for the effect of inlet air temperature and had nearly identical results.

RAILWAY

REFER ALSO TO CITATION(S) 57148

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 56882

57138 (CONF-7508106—(Summ.)) **Summary of Kansas City Consumer Energy Workshop and list of participants.** (Federal Energy Administration, Washington, DC (USA)). 1975. 23p. Dep. NTIS, PC A01/MF A01.

From Consumer energy workshop; Kansas City, MO, USA (8 Aug 1975).

The conclusions arrived at during the consumer energy workshop are summarized. Topics discussed included energy program for the aged and poor; energy conservation; energy and the environment; energy and agriculture; utility rates and natural gas usage; resource development; and deregulation of fuel prices. (LCL)

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 56930, 57079

57139 (CAES—462-A-77) **Cupola furnace: state-of-the-art.** Draper, A.B.; Keith, R.E.; Sylvia, J.G. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). May 1977. Contract EY-76-S-02-2840. 166p. Dep. NTIS, PC A08/MF A01.

The evolution of cupolas, i.e., furnaces used to melt cast irons, is reviewed. The design and operation of hot-blast, cold-blast, and novel cupolas, energy conservation and air pollution control aspects of cupola operation, and the mathematical modeling of cupolas are discussed. (LCL)

57140 (CAES—504-78) **Cupola furnace: machine-readable bibliographic data base.** Keith, R.E. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). 1978. Contract EY-76-S-02-2840. 76p. Dep. NTIS, PC A05/MF A01.

One of the tasks comprising ERDA Contract EY-76-S-02-2840, "Minimization of Cupola Energy and Air Pollution," has been the carrying out of a comprehensive survey of world literature relating to the cupola furnace for melting of cast iron. It was decided to computerize the literature references acquired in order to facilitate future searching of the bibliographic data base and to provide for its convenient extension and enlargement. This document describes the data base, how to search it, and how to add and edit references. Included are a number of instructions and cautionary notes for persons having responsibility for its management in the future.

57141 **Electric boilers up to 175,000 pounds per hour: available designs and current applications.** Heil, T.J.; Leatham, C.H. Jr. (Gilbert/Commonwealth, Jackson, MI). *Proc. Am. Power Conf.;* **39**: 735-743(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The types of, design, operation, and economics of electric boilers for industrial applications are discussed. A number of industrial electric boilers of the 100,000 16/h size are in operation in the U.S.. They have the advantages of less space requirements, no combustion systems, no fuel or ash handling, simplicity of operation, and fewer adverse environmental effects. The capital costs of an electric boiler is less than for a fossil-fuel-fired unit, but the cost of purchased Btus is greater for electric power than for coal. The capital cost savings and environmental advantages must be balanced against the great cost of purchasing electric power instead of coal. (LCL)

57142 **Impact of higher energy costs on turbine system selection for industry.** Kovacik, J.M. (General Electric Co., Schenectady, NY). *Proc. Am. Power Conf.;* **39**: 765-773(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Industrial plants which require both process heat and electric power should evaluate plant energy supply systems to determine whether turbines, providing electric and/or shaft power, can improve their effective use of energy. The economic and energy considerations in such an evaluation are discussed. It is concluded that with rapidly rising fuel costs, in-plant power generation for industries requiring large quantities of process heat should continue to conserve energy resources and reduce product costs. (LCL)

WASTE HEAT RECOVERY AND UTILIZATION

57143 (CONF-780367—1) **Analysis of economic and energy utilization aspects for waste heat aquaculture.** Olszewski, M.; Wilson, J.V. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 2. waste heat aquaculture workshop; New Brunswick, NJ, USA (29 Mar 1978).

A waste heat aquaculture system using extensive culture techniques to produce fin and shellfish is currently under investigation at the Oak Ridge National Laboratory. The system uses nutrients in waste water streams to grow algae and zooplankton which are fed to fish and clams. A tilapia polyculture association and the freshwater clam Corbicula are the animals cultured in the system. The investigations were performed to determine the economic feasibility of the system and examine energy utilization in the system. A net energy analysis was performed to identify the energy saving potential for the system. This analysis includes all energy costs (both direct and indirect) associated with building and operating the system. The results of the economic study indicated that fish production costs of $0.55/kg ($0.25/lb) were possible. This cost, however, depends upon the fish production rate and food conversion efficiency and could rise to as much as $1.65/kg ($0.75/lb). Clam production costs were found to be in the neighborhood of $0.37/kg of clam meat ($1.24/bushel). The energy utilization study results indicated that, when all energy costs are included, fish from the aquaculture system may require only 35% of the net energy now required for fish products from the ocean. However, the energy requirements also depend on system parameters and could be as large as the energy required for ocean caught products. Clams can be produced in the aquaculture system using only about 25% of the net energy required by traditional means. The results of the analysis indicate that the system appears to be economically feasible. They also indicate that significant energy savings are possible if waste heat aquaculture products replace ocean caught products.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 56384, 56389, 56462, 56890, 56891, 56892, 56899

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 57058

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 56893

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

SPARK-IGNITION

REFER ALSO TO CITATION(S) 57149

57144 Relationships among engine variables, exhaust gas emissions and fuel economy in gasoline engines. Saito, A.; Koga, K.; Kaneko, Y.; Kawabata, M.; Motomochi, M. *Tech. Rev., Mitsubishi Heavy Ind.;* **15**: No. 1, 54-61(Feb 1978).

Numerous research papers have been published concerning the effects of the engine variables, such as compression ratio, air/fuel ratio, spark timing and exhaust gas recirculation (EGR), on exhaust gas emissions and fuel economy. However, it has not yet been made fully clear how to set these variables in order to reduce the emissions of exhaust gases, such as HC, CO and NOx, while keeping the increase of fuel consumption at a minimum. Investigations were made on the effects of the engine variables on exhaust gas emissions and fuel economy by use of a single cylinder gasoline engine having a conventional hemispherical combustion chamber; the results of which are briefly as follows: (1) A higher compression ratio is effective for better fuel economy; however, it causes a substantial increase of HC emissions. If an increase of HC emissions is not acceptable and must be controlled by retarding spark timing, the optimum compression ratio is considered to be 8.5 : 1 to 9 : 1. (2) The best fuel economy can be obtained by applying a suitable EGR rate with a leaner air/fuel ratio set as far as driveability permits and spark timing set at MBT. But there is a reduction limit of NOx emissions even if this method is adopted. (3) In the case of reducing NOx emissions to the level of 2 to 3 g/PS . h, a leaner air/fuel ratio greater than 16 : 1 will result a sharp increase of HC emissions, worsening the driveability of the automobile. To minimize fuel consumption in this case, enriching the air/fuel ratio to 15 : 1 to 14.5 : 1 and retarding the spark timing within 10 degrees from MBT will be effective.

TURBINE

57145 (AMMRC-TR—78-14(Vol.2)) **Brittle materials design, high temperature gas turbine. Volume 2. Ceramic turbine rotor technology. 12th interim report, January—September 1977.** McLean, A.F.; Baker, R.R. (Ford Motor Co., Dearborn, MI (USA)). Mar 1978. Contract EY-76-C-02-2630. 105p. Dep. NTIS, PC A06/MF A01.

Investigations of the materials used to fabricate duo-density ceramic turbine rotors were conducted on injection molded reaction bonded and hot pressed silicon nitride. The injection molding process, utilized to fabricate rotor blade rings, was improved by optimizing the molding parameters with the automated control system and improving the molding mixture. Duo-density turbine rotors were tested in the cold spin pit to evaluate the hot press to reaction sintered bond joints and the effect of I.D. voids, in the blade ring rim, on blade failure speeds. A procedure for determining whether statistically significant differences exist between two sets of data, known as the 'Hypothesis Testing' was outlined. The test was applied to data from duo-density turbine rotors and showed that blade strength did deteriorate after the press-bonding operation. (TFD)

ELECTRIC-POWERED SYSTEMS

57146 (DOE/NASA/1011—78/27) **Cycle timer for testing electric vehicles.** Soltis, R.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EX-76-A-31-1011. 10p. (CONF-781006—1; NASA-TM—78934). Dep. NTIS, PC A02/MF A01.

From 5. symposium on electric vehicle; Philadelphia, PA, USA (2 Oct 1978).

A cycle timer was developed to assist the driver of an electric vehicle in more accurately following and repeating SAE driving schedules. These schedules require operating an electric vehicle in a selected stop-and-go driving cycle and repeating this pattern until the vehicle ceases to meet the requirements of the cycle. The heart of the system is a programmable read-only memory (PROM) that has the required test profiles permanently recorded on plug-in cards, one card for each different driving schedule. The PROM generates a direct-current analog signal that drives a speedometer displayed on one scale of a dual-movement meter. The second scale of the dual-movement meter displays the actual speed of the vehicle as recorded by the fifth wheel. The vehicle operator controls vehicle speed to match the desired profile speed. One second before a speed transition (such as acceleration to cruise or cruise to coast), a small buzzer sounds for $\frac{1}{2}$ s to forewarn the operator of a change. A longer signal of 1 s is used to emphasize the start of a new cycle. The PROM controls the recycle start time as well as the buzzer activation. The cycle programmer is powered by the test vehicle's 12-V accessory battery, through a 5-V regulator and a 12-V dc-to-dc converter.

VEHICLE DESIGN FACTORS

57147 Hong Kong mass transit railway. Winney, M. *Constr. News Mag.;* **4**: No. 5, 14-17(May 1978).

A description is given of the construction progress of the Hong Kong mass transit railway. The railway is expected to be carrying nearly two million passengers a day by the mid 1980s. Excavation of the underground terminals and tunnels is described in detail. (PMA)

57148 Solution to the problem of rail corrugation. Srinivasan, M. (Wagon India Ltd., New Delhi). *J. Inst. Eng. (India), Civ. Eng. Div.;* **58**: 195-201(Jan 1978).

Corrugation of rails was first observed in India over 80 years ago and the only known remedy was grinding. So far a more satisfactory solution could not be found. Corrugation is undesirable as it increases the fuel consumption (by as much as 10 percent) and maintenance expenditure. A solution for prevention of corrugation of rails by increasing the track modulus is presented.

ENGINE SYSTEM

57149 Development of a new combustion system (MCA-JET) in gasoline engine. Nakamura, Y.; Kiyota, Y.; Akishino, K.; Tsukamoto, Y.; Hori, K.; Nakagami, T.; Ohinoue, T. *Tech. Rev., Mitsubishi Heavy Ind.;* **15**: No. 1, 46-53(Feb 1978).

In the development of gasoline engines for passenger cars in the past, priority was given to the improvement of their performance under high load conditions, and the problem of reducing fuel consumption under low speed/low load conditions under which automobiles are frequently operated in city driving seems to have been left unsolved. Countermeasures such as the leaning of mixture and the recirculation of exhaust gas have been adopted to conform to the recent exhaust gas control regulations. However, since these control regulations are oriented to low speed/low load conditions, these countermeasures are apt to cause further worsening of combustion under such conditions. Efforts were made for the improvement of combustion under such conditions and a new combustion system was developed without making a big change in the conventional combustion chamber design, but only by installing a simple small-sized jet valve in it. The system shows: (1) reduction of fuel consumption particularly under low speed/low load conditions as in city driving; (2) recirculation of a large amount of exhaust gas for a minimum of NO/sub x/ emission; and (3) the least power loss at W.O.T. with stable combustion at very low engine speed. The development of the new combustion system and the results of an analysis of its combustion characteristics are discussed.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 56587

57150 (PB—276922) **Motorcycle emission control demonstration. Final report April—November 1977.** Ullman, T.L.; Hare, C.T. (Southwest Research Inst., San Antonio, TX (USA)). Dec 1977. Contract EPA-68-03-2391. 443p. (SwRI-AR—1230). NTIS PC A19/MF A01.

The testing of ten motorcycles for exhaust emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) is described. Emission rates in grams per kilometer are presented for the 1975 Federal Test Procedure and the Highway Fuel Economy Test, as well as in percent or parts per million for several steady-state conditions. The test motorcycles were equipped with 2-stroke, 4-stroke, and rotary engines ranging from about 100 to 1000 cc displacement. Several exhaust emission control techniques were applied, including minor and major carburetor enleanment with and without capacitive discharge ignition, secondary air injection with both pumps and reed valves, port liners, thermal reactors, oxidation catalysts, rotary valve modification, a spark ignited afterburner, and a short-circuited air-fuel mixture extraction system. Driveability, performance, and maladjustment (stock only) testing were also performed. All testing was performed with low accumulated distance on the motorcycles. (Portions of this document are not fully legible)

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 57144, 57149

57151 Internal combustion engine with an exhaust gas recirculating device. Wakita, N.; Yuuki, K. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,095,569. 20 Jun 1978. Priority date 15 Oct 1976, Japan. 6p.

An internal combustion engine with an exhaust gas recirculating system is described. The engine has a movable shroud. The shroud is positioned near the rear surface of the valve head of the intake valve so as to obstruct a part of the mixture stream flowing through the valve opening of the intake valve for creating the swirl motion of the mixture in the combustion chamber when the amount of the recirculated exhaust gas is larger than a predetermined level. The shroud is retracted to a position where the shroud does not obstruct the mixture stream flowing in the intake port of the engine when the amount of the recirculated exhaust gas is smaller than said predetermined level.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 57144

HYDROCARBONS

REFER ALSO TO CITATION(S) 57144

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 57135

MATERIALS

REFER ALSO TO CITATION(S) 57812

57152 (PB—278639) **An agenda for technology assessment in the materials field. Volume I. Principal findings.** Christakis, A.; Globe, S.; Kawamura, K.; McGirr, D.F. (Battelle Columbus Labs., OH (USA)). 24 Mar 1978. 66p.

An agenda for technology assessment in the field of materials was developed through a process of dialogue among experts by use of a procedure known as a 'science forum'. The science forum is intended to promote consensus through a dialectic that synthesizes the views from differing perspectives. In this project two science forums were conducted. In the first, the views of materials scientists and materials technologists (collectively the 'SandT experts') were synthesized to produce a forecast of materials technologies for the ensuing two decades. From these technologies a list of 21 'TA Candidates', which are proposed topics for technology assessment, was developed. The ratings of the TA Candidates were treated statistically by the core team to rank them as to urgency. From the rankings as to urgency, the five topics selected as meriting highest priority for full technology assessment are the following: Biodegradable plastics; Conversion of coal to cleaner fuels; Electric power generation and transmission; Materials for nuclear systems; Mining of ocean nodules.

57153 (PB—278640) **An agenda for technology assessment in the materials field. Volume II. Appendices.** Christakis, A.; Globe, S.; Kawamura, K.; McGirr, D.F. (Battelle Columbus Labs., OH (USA)). 24 Mar 1978. 178p.

The contents are as follows: Appendix A - Questionnaires; Appendix B - Forecasts; Appendix C - Assessments; Appendix D - Miscellaneous materials.

METALS AND ALLOYS

57154 (GEFR—00067-2) **Program for the development of design data: LMFBR steam generator materials.** (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). 7 Jun 1978. Contract EY-76-C-03-0893-030. 241p. AT.

A program to characterize materials, mainly 2¼ Cr-1 Mo steel and austenitic stainless steels, to assure that satisfactory materials compatibility is achieved with LMFBR steam generator environments is reported, along with a program for steam generator materials qualification. The objectives of the second program are to develop and qualify materials specifications, to develop fabrication procedures and processes, to purchase tubing and tubesheet material for development programs, to develop and apply nondestructive examination techniques for the Intermediate Heat Transport System of the CRBRP, to coordinate design of the steam generators in the area of water chemistry, to provide technical management to wear and friction testing of IHTS material, and to develop the design and fabrication procedures for the austenitic stainless to ferritic steel transition joints of the CRBR. (GHT)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 57154, 57434

57155 (AD-A—051155) **Machine casting of ferrous alloys. Final report, 30 June 1976—30 June 1977.** Flemings, M.C.; Young, K.P.; Boylan, J.F.; Bye, R.L.; Santor, M.L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jun 1977. Contract DAAG46-73-C-0110. 94p. NTIS PC A05/MF A01.

During this year the basic Rheocasting system, which was fully operational at the beginning of the year, was improved in various ways to increase reliability and productivity. Specific improvements were the addition of a reducing gas in the melting chamber, a shield gas extension nozzle and graphite inserts at the bottom of the Rheocaster to eliminate 'hot spots'. Large quantities of 304 and 440C stainless steel alloys were cast during this period (approximately 800 pounds of 304 and 2000 pounds of 440C) and smaller quantities of other materials were also Rheocast including M2 tool steel, and HS 31 Cobalt base superalloy. Improvements in details and automation of the Thixocasting process were also made during this period. Work subsequently concentrated on casting large quantities of stainless steel into various die materials in order to determine die life and to optimize that die life.

57156 (ANL—78-29) **Ultrasonic wave-propagation characteristics and polarization effects in stainless steel weld metal.** Kupperman, D.S.; Reimann, K.J. (Argonne National Lab., IL (USA)). Mar 1978. Contract W-31-109-ENG-38. 25p. AT.

Ultrasonic inspections of austenitic stainless steel weld metal are particularly difficult because of the dendritic structure and anisotropy of the material. The acoustic properties of stainless steel weld metal are discussed. Data on frequency spectra and variations in longitudinal and shear velocities with wave-propagation direction are presented. The difference in detectability of artificial reflectors using shear waves of varying polarization is presented, and it is demonstrated that, in some cases, horizontally polarized shear waves can "detect" a reflector in the weld metal, whereas the traditional vertically polarized shear waves cannot.

57157 (BMFT-FB-K—77-18) **Tungsten-Inert-Gas-(TIG) welding of zircaloy fuel rods under 40 bar helium-gas.** Koehler, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Sep 1977. 30p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

TIG-Welding in a clean helium atmosphere was investigated with a gas pressure up to 40 bar. The technology for the application in fabrication is feasible when pressure filling-bore are welded. A more economical pressure welding of end plugs without pressure filling-bores is possible up to 30 bar, though some problems exist with respect to the welding-porosity. Welding under pressure is also possible up to 40 bar; additional difficulties arise from a limitation of the regulation of the welding arc current.

57158 (CONF-780609—6) **Half-bead weld repairs for in-service applications.** Holz, P.P. Sr. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 20p. Dep. NTIS, MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

Portions of document are illegible.

Successful half- or temper-bead technique weld repairs performed to Section XI of the American Society of Mechanical

Engineers Boiler and Pressure Vessel Code guidelines were made to two Heavy-Section Steel Technology Program vessels and a qualification prolongation. Intermediate sized vessels, equivalent in thickness to nuclear pressure vessels, were repair welded and subsequently flawed and pressure tested to approximately 2¼ times design pressure before leakage occurred. Discussed are the standards and procedures used with half-bead repairs, resultant induced metallurgical and stress effects, flaw test criterion, pressure test details and results, and recommendations for further development work for a speedier application process.

57159 (GEFR—00244(Vol.1)) **Effects of remelting and heat treatment on 2-1/4Cr—1Mo steel: microstructure and mechanical properties.** Offer, H.P.; Ring, P.J. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Sep 1977. Contract EY-76-C-03-0893-010. 109p. AT.

In order to validate the design assumptions for consumable remelted 2¼ Cr-1 Mo steel subjected to thorough annealing and post weld heat treatment, a series of mechanical property tests and microstructural examinations were conducted. Both vacuum arc remelted (VAR) and electroslag remelted (ESR) processes were evaluated.

57160 (LBL—7301) **Investigation into the production of metastable Nb_3Ge powder via the rotating electrode process.** McCormick, J.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

Thesis.

The production of metastable Nb_3Ge powder via the rotating electrode process (REP) employing "splat cooling" was investigated. An electrode capable of withstanding the thermal shock of the electric arc used in REP was produced through powder metallurgy techniques. The effect of various parameters involved in the rotating electrode process was studied in correlation with process control and crystal structure, microstructure and compositional analyses of the powder produced. Superconducting transition temperature measurements were made on the powder both as-produced and after annealing experiments.

57161 (NTIS/PS—78/0163) **Tungsten and tungsten alloy powder metallurgy (citations from the NTIS data base). Report for 1964—February 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 122p. NTIS PC N01/MF N01.

Federally-funded studies on fabricating and processing of tungsten, its alloys and composites are cited. Methods described include compacting, pressing, sintering, extruding and rolling. Infiltration of porous tungsten shapes is also covered. The mechanical properties, thermal properties and microstructure of these products are reported. Some products studied are rocket nozzles, nuclear reactor materials, and porous ionizers. (Contains 117 abstracts)

57162 (NTIS/PS—78/0164) **Tungsten and tungsten alloy powder metallurgy (citations from the Engineering Index data base). Report for 1964—February 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 164p. NTIS PC N01/MF N01.

Worldwide journal articles are cited on tungsten powder preparation and processing. Studies include sintering, densification, shrinkage, phase analysis, and heat treatment. The physical and mechanical properties of tungsten powder metal products are included. The effects of additives and particle size on the sintering and sintered articles are also described. (contains 157 abstracts)

57163 (ORNL/TM—6276) **Weldability testing of alloy 800.** King, J.F.; Reed, R.W. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1978. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

The weldability of various heats of alloy 800 was compared by the Tigamajig hot-cracking test. This testing was conducted to determine if the test could rank the relative hot-cracking tendencies of the various heats and therefore provide a measure of weldability for future alloy 800 heats before their being assigned to nuclear component fabrication. The test accurately detected a heat that had exhibited hot-cracking in the heat-affected zone of actual weldments. Neither this work nor that of other investigators has been able to specify a chemical analysis for alloy 800 that will "always" be weldable. This test can, however, be used to provide a relative measure of weldability for critical applications.

57164 (TREE—1217) **Welding technology development. Quarterly progress report, October—December 1977.** Chopp, J.A.; Eichenberger, G.D.; Turner, P.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1978. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

Fourteen narrow-groove joints were welded on 0.91-m (36-in.) diameter AISI 316 stainless steel pipe. These joints were made by the automatic GTAW process, employing an Astro-Arc orbiting welding head and a 300-ampere, four-level, pulsed-arc power supply. Three different types of welding wire, ER 308, ER 316, and 16-8-2, were used. End preparations were made using a Crutcher Resources Corporation (CRC) pipe-facing machine. CRC's internal and external line-up clamps were employed for alignment and clamping. Longitudinal and radial shrinkage and ferrite measurements were taken on each weld.

57165 (TREE—1253) **Reference heat of Alloy 718 for Department of Energy programs.** Smolik, G.R.; Korth, G.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1978. Contract EY-76-C-07-1570. 128p. Dep. NTIS, MF A01.

Portions of document are illegible.

Activities associated with the procurement of Alloy 718 reference material are presented and products processed from this material are characterized. Characterization includes descriptions of traceability and manufacturing processes. Microstructural, chemical and mechanical property information provided as part of the procurement is also included. Metallographic results of recrystallizaion studies have been presented to assist in the selection of annealing temperatures for products supplied in the as-forged condition. A complete list of the various product types is given, along with procedures for requesting material for test programs.

57166 **Annealing behavior and selected applications of ion-implanted alloys.** Myers, S.M. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Vac. Sci. Technol.;* **15**: No. 5, 1650-1655(Sep 1978).

Thermally activated processes cause ion-implanted metals to evolve from the initial state toward thermodynamic equilibrium. The degree of this equilibration is strongly dependent upon temperature, and is considered here for three temperature regimes which are distinguished by the varying mobilities of interstitial and substitutional atoms. In addition, perturbations resulting from the irradiation environment are discussed. Examples are given of the use of implanted and annealed alloys in studies of diffusion, phase diagrams, and solute trapping.

STRUCTURE AND PHASE STUDIES

57167 (LBL—7361) **Role of quaternary additions on dislocated martensite, retain austenite and mechanical properties of Fe/Cr/C structural steels.** Rao, B.V.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1978. Contract W-7405-ENG-48. 186p. Dep. NTIS, PC A09/MF A01.

Thesis.

The influence of quaternary alloy additions of Mn and Ni to Fe/Cr/C steels which have been designed to provide superior mechanical properties has been investigated. Transmission electron microscopy and x-ray analysis revealed increasing amounts of retained austenite with Mn up to 2 w/o and with 5 w/o Ni additions after quenching from 1100°C. This is accompanied by a corresponding improvement in toughness properties of the quaternary alloys. In addition, the generally attractive combinations of strength and toughness in these quaternary alloys is attributed to the production of dislocated lath martensite from a homogeneous austenite phase free from undissolved alloy carbides. Grain-refining resulted in a further increase in the amount of retained austenite.

57168 (LBL—7622) **Valence band photoemission studies of clean metals.** Wehner, P.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 119p. Dep. NTIS, PC A06/MF A01.

Thesis.

The application of Angle-Resolved Photoelectron Spectroscopy (ARPES) to crystalline solids and the utilization of such studies to illuminate several questions concerning the detailed electronic structure of such materials, are discussed. Specifically, by construction of a Direct Transition (DT) model and the utilization of energy-dependent angle-resolved normal photoemission in the photon energy range 32 eV $<$ or $=$ $h\nu$ $<$ or $=$ 200 eV, the bulk band structure of copper is experimentally mapped out along three different directions in the Brillouin Zone; GAMMA to K, GAMMA to L, and GAMMA to X. In addition, various effects which influence the obtainable resolution in vector k-space, namely, thermal disorder, momentum broadening, and band mixing, are discussed and are shown to place severe limitations on the applicability of the DT model. Finally, a model for Angle-Resolved X-ray Photoelectron Spectroscopy (ARXPS) based on the symmetry of the initial-state wavefunctions is presented and compared to experimental results obtained from copper single crystals.

57169 **Extended x-ray—absorption fine structure of surface atoms on single-crystal substrates: Iodine adsorbed on Ag(111).** Citrin, P.H.; Eisenberger, P.; Hewitt, R.C. (Bell Laboratories, Murray Hill, New Jersey 07974). *Phys. Rev. Lett.;* **41**: No. 5, 309-312(31 Jul 1978).

An Auger variant of the x-ray—absorption fine-structure (EXAFS) technique has been successfully applied to study the

adsorption site and adsorbate-substrate bond length in a single-crystal system. The surface-EXAFS technique should have widespread applications in surface crystallographic studies.

57170 Identification of a surface state of the (111) terraces of stepped Cu(211). Williams, R.S.; Wehner, P.S.; Kevan, S.D.; Davis, R.F.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **41**: No. 5, 323-326(31 Jul 1978).

The surface electronic structure of a stepped Cu(211) crystal was elucidated by angle-resolved photoemission spectroscopy. A surface state was found on the three-atom terraces, indicating that the terrace surface potential resembles that of a Cu(111) crystal surface. The d-band dispersion relations of Cu(211) were also found to resemble bulk copper closely. The observed enhanced reactivity of the stepped surface does not appear to arise from gross changes in the surface electronic structure.

57171 Complete solution of the Korringa-Kohn-Rostoker coherent-potential-approximation equations: Cu-Ni alloys. Stocks, G.M.; Temmerman, W.M.; Gyorffy, B.L. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge Tennessee 37830). *Phys. Rev. Lett.;* **41**: No. 5, 339-343(31 Jul 1978).

We report on calculations of the electronic states in disordered Cu/sub c/Ni/sub(1-c/) alloys based on a complete solution of the coherent-potential approximation for a muffin-tin model of the alloy potential [Korringa-Kohn-Rostoker coherent-potential-approximation (KKR-CPA)]. The computational effort required is modest on the scale of that involved in band-structure calculations for many atoms per unit cell. Th calculated densities of states are in good agreement with the results of photoemission and other experiments. The adequacy of previous approximate KKR-CPA and averaged t-matrix calculations is discussed.

57172 Anomalies of magnetic and electric properties on change of topology of the Fermi surface in terbium-yttrium alloys. Belov, K.P.; Nikitin, S.A.; Sheludko, N.A.; Posyado, V.P.; Chuprikov, G.E. (Moscow State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 140-144(Jul 1977).

On the basis of experimental data on the concentration dependence of the magnetic, magnetostrictive, and electrical properties of terbium-yttrium alloys, the conclusion is drawn that upon change of the concentration of the components in these alloys, there occurs a phase transition of order 2 1/2, caused by a substantial reconstruction of the Fermi surface when terbium is alloyed with yttrium.

57173 Quasilocal vibrations produced in dilute V/sub 1hyphenx/Pt/sub x/ alloys under conditions of a strong restructuring of phonon spectrum of V. Syrykh, G.F.; Zemlyanov, G.M.; Chernoplekov, N.A.; Koltygin, V.M. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 162-164(Jul 1977).

Results are presented of the measurements of the spectra of inelastic incoherent scattering of neutrons by V/sub 1hyphenx/Pt/sub x/ alloys (x=5 and 7 at.%). In the low-frequency regions of the spectra, quasilocal vibrations (QLV) are observed and are connected with introduction of the heavy impurity Pt atoms into the V. The energy position of the QLV is shifted in the region of higher values in comparison with those expected in isotopic-substitution model. Introduction of the Pt atoms leads also to a shift of the entire spectrum towards higher frequencies. The shift of the QLV and of the entire spectrum depends on the concentration of the impurity atoms. The energy position of the QLV can be satisfactorily explained within the framework of isotopic substitution using a renormalized spectrum of the original lattice.

57174 Isothermal studies of bainitic and martensitic transformations in some low alloy steels. Ericsson, C.E. (Caterpillar Tractor Co., Peoria IL); Bhat, M.S.; Parker, E.R.; Zackay, V.F. *Metall. Trans., A;* **7**: 1800-1804(Nov 1976).

The transformation kinetics of the upper and lower bainitic reactions were determined for four commercial quenched and tempered steels, AISI 4130, AISI 4140, D6AC and AMS 6416 (300-M). Their chemical compositions are given. The kinetics of the bainite reaction below the martensite start temperature (M/sub s/) was determined.

57175 Multiphonon resonant Raman scattering in GaSe. Camassel, J.; Chiang, T.C.; Shen, Y.R.; Voitchovsky, J.P.; Amer, N.M. (Univ. of California, Berkeley). *Solid State Commun.;* **19**: No. 6, 483-485(1976).

Multiphonon resonant Raman scattering up to 4 phonons in GaSe has been measured. The results are interpreted by a simple cascade theory. It is shown that the dispersion of RRS here is dominated by resonances with the exciton states.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 56367, 57159, 57174

57176 (CONF-780609—8) **Analytical representation of the creep and creep-rupture behavior of Alloy 800H.** Booker, M.K. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 50p. Dep. NTIS, PC A03/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

The extensive use of Alloy 800 (including the 800H variation) in elevated-temperature applications requires that the mechanical properties of this material be well characterized and understood. In the present investigation, available creep and creep-rupture data for Alloy 800H have been collected and analyzed. Results include mathematical models describing time and strain to rupture, time and strain to tertiary creep, and creep strain-time behavior as functions of stress and temperature.

57177 (CONF-780818—5) **Application of an analytical electron microscope to surface deformation and wear research.** Carpenter, R.W. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 2p. Dep. NTIS, PC A02/MF A01.

From Electron microscopy conference; Toronto, Canada (1 Aug 1978).

Multiple imaging modes of an analytical electron microscope, TEM/STEM and SEM, together with single surface thinning methods permit direct examination of both the external worn surface and immediately underlying deformation substructure in one instrument. The use of this method to examine stylus tracks on aluminum is described. (GHT)

57178 (ORNL/CSD—33) **Time-independent limit of a creep-recovery constitutive equation.** Chang, S.J. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 37p. Dep. NTIS, PC A03/MF A01.

The effort of strain recovery is taken into consideration in ORNL efforts to establish unified constitutive equation of time-dependent plastic deformation for metals at elevated temperatures. Representation by internal state variables and Rice's flow potential are under consideration. Here the growth law for the internal state variables is discussed and interpreted in terms of a generalized form of the kinematic hardening condition of Prager. Yield condition is obtained from the flow potential representation of the inelastic strain rate. A consistency condition is derived from the yield condition and leads to a flow rule which assumes a slightly general form as compared with that of the classical plasticity due to the effect of strain recovery and the time-dependent property of the yield condition. Based on this representation, the time-independent limit is discussed. From a vanishing effect of recovery and rate-independent limit for the yield condition at low temperature, this flow rule reduces to the well-known form of time-independent plasticity with a kinematic hardening condition. The duration of time (the characteristic time) required for the inelastic strain to reach its saturated value is defined for the inelastic loading condition. It provides the measure of a minimum duration of time which is required for a valid apoproximation made by the time-independent plasticity model.

57179 (ORNL/TM—6232) **Interim analytical representation of the creep strain-time behavior of commercially heated-treated Alloy 718.** Booker, M.K. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 57p. AT.

Recently obtained creep and creep-rupture data for commercially heat-treated, duplex-aged Alloy 718 were analyzed to yield analytical predictions for rupture life, time and strain to tertiary creep, and creep strain-time behavior. When strain-time data were normalized to the strain and time to tertiary creep, all data fell on a single "master creep curve". Finally, limited stress-relaxation and variable-load creep data were used to make preliminary observations concerning possible hardening laws for use with Alloy 718 in design analyses. All results are intended for interim use only. The results listed above are to be used in the temperature range from 538 to 760°C at stresses from 138 MPa to the 10-hr rupture strength at temperature. All results were developed primarily from a single heat of plate material and therefore may not be generally applicable.

57180 (UNI—993) **Documentation of the stress intensity factor calibration used for the fracture toughness evaluation of N Reactor pressure tube 1350.** Scott, K.V. (United Nuclear Industries, Inc., Richland, WA (USA)). 27 Feb 1978. Contract EY-76-C-06-1857. 18p. Dep. NTIS, PC A02/MF A01.

The evaluation program is a requirement of the N Reactor Technical Specifications. The results of the evaluation from a particular pressure tube are due one year from the date of removal and are the basis for assessing the nuclear safety adequacy of the tubes and for establishing the next removal date. The bases for the stress intensity factor expression applied to the evaluation of recent pressure tube fracture toughness tests are documented. (GHT)

57181 Friction and wear of lead in superconducting and normal states. Verkin, B.I.; Guslyakov, A.A.; Kuleba, V.I.; Lyubarskii, I.M.; Pustovalov, V.V. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 752-754(Dec 1977).

It has been found that the superconducting transition affects friction and wear of lead at 4.2 °K in liquid helium.

57182 Blunting of a plane strain crack tip into a shape with vertices. McMeeking, R.M. (Brown Univ., Providence, RI). *J. Eng. Mater. Technol.;* **99**: No. 4, 290-297(Oct 1977).

When monotonically increasing tensile opening loads are applied to a cracked, plane strain, elastic-plastic body, the crack tip will blunt until fracture occurs. The blunted tip shape may have two or more sharp corners, or be smoothly curved. When the shape involves corners, the opening is predominantly accommodated by shearing of the material at the corners. This shearing transports material from the interior of the body onto the crack surface. In contrast, the smoothly blunted crack tip involves no transfer of material points from the interior. However, the smoothly blunted crack, which was originally sharp, involves infinite strains on the crack tip surface. The crack with corners on the tip has large but finite strains on the crack tip surface. The stress and deformation field in front of a crack with two corners and with three corners on the tip, as calculated using the slip line method, is presented for the non-hardening, fully plastic, deeply cracked, double edge-notched thick panel. As in the case of the smoothly blunted crack tip, the elevated stress between the crack tips cannot be maintained very close to the crack tip, due to a lack of constraint. The stress distribution in the case of the crack tip with vertices on it differs from that of the smoothly blunted crack tip case. Immediately in front of the crack tip with three corners, the stress is higher than that immediately in front of the smoothly blunted crack tip. An approximation for a power law hardening material indicates that the maximum stresses near the blunted crack tip are much the same for a crack with vertices on the tip as for a smoothly blunted crack tip. The details of the stress distribution will depend on the mechanism by which the crack blunts. Results for stress and strain and some calculations of the growth of voids near the crack tips indicate the same fracture process could lead to different fracture toughnesses, depending on the type of mechanism by which the crack blunts.

57183 Enhancement of fatigue crack growth and fracture resistance in Ti—6Al—4V and Ti—6Al—6V—2Sn through microstructural modification. Yoder, G.R.; Cooley, L.A.; Crooker, T.W. (Naval Research Lab., Washington, DC). *J. Eng. Mater. Technol.;* **99**: No. 4, 313-318(Oct 1977).

Significant enhancement in fatigue crack propagation resistance and plane strain fracture toughness was obtained in commercial purity Ti-6Al-4V and Ti-6Al-6V-2Sn through microstructural modification. Alloys studied were in the form of 25.4 mm-thick plate with interstitial oxygen contents of 0.20 and 0.17 weight percent, respectively. Heat treatments were chosen to provide widely varied microstructures; these included a mill anneal, recrystallization anneal and a beta anneal. The most beneficial heat treatment for improving these crack tolerance properties was found to be the beta anneal. However, the beta anneal resulted in yield strength reductions of 9 to 14 percent, from levels associated with the original mill anneal. The recrystallization anneal provided significant enhancement of plane strain fracture toughness and marginal improvement in fatigue crack propagation resistance with negligible loss of yield strength.

57184 Further dynamic finite element analysis of the tapered DCB specimen. Urabe, Y.; Kobayashi, A.S.; Emery, A.F.; Love, W.J. (Univ. of Washington, Seattle). *J. Eng. Mater. Technol.;* **99**: No. 4, 324-328(Oct 1977).

A dynamic finite element code was used to compute the dynamic stress intensity factors and crack arrest stress intensity factor which are related to the crack run-arrest response in a tapered double cantilever beam (DCB) specimen machined from A533B steel. Measured crack velocities of a fracturing tapered DCB specimen were used to prescribe a crack motion under both fixed grip and variable loading conditions at the two loading pins. Numerically and experimentally determined dynamic strains were compared at three locations on the fracturing tapered DCB specimen. This comparative study showed that the fixed grip condition modeled the actual dynamic state well and that the crack arrest stress intensity factor, K/sub Iα/, computed on the bases of fixed grip and variable loading conditions differed by a factor of approximately 0.6.

57185 Strain rate effects on the elevated-temperature tensile behavior of a bainitic 2 1/4 Cr—1 Mo steel. Klueh, R.L. (Oak Ridge National Lab., TN); Oakes, R.E. Jr. *J. Eng. Mater. Technol.;* **99**: No. 4, 350-358(Oct 1977).

The tensile properties of a normalized-and-tempered 2-¼ Cr-1 Mo steel were determined from 25 to 566°C and the strain rate 2.67×10^{-6} to 144/s. The specimens were taken from a 1-in. thick plate and had a microstructure that was essentially 100 percent bainite. Except at 25 and 566°C, the 0.2 percent yield stress was little affected by strain rate; at 25 and 566°C, the yield stress increased with increasing strain rate. At a constant strain rate, the yield stress decreased with increasing temperature. The effect of strain rate and temperature on the ultimate tensile strength was more complicated. A strength peak that resulted from dynamic strain aging was observed in the ultimate tensile strength-temperature relationship. The position of these peaks moved to higher temperatures with increasing strain rate. Total elongation and reduction of area were relatively constant over the range of test variables, except at 566°C, where they increased with decreasing strain rate. However, uniform elongation decreased with decreasing strain rate at 510 and 566°C, dropping to 1 and 0.6 percent, respectively.

57186 Representation of elevated-temperature tensile behavior of Type 304 stainless steel in a sodium environment. Chopra, O.K.; Natesan, K. (Argonne National Lab., IL). *J. Eng. Mater. Technol.;* **99**: No. 4, 366-371(Oct 1977).

An analysis of tensile behavior of Type 304 stainless steel was conducted for specimens in the solution-annealed condition and after exposure to a sodium environment. The Voce equation was used to describe tensile flow curves for plastic strains above 0.005 at temperatures between 550 and 700°C and strain rates of 3.81×10^{-6} to $1.90 \times 10^{-3}\ s^{-1}$. The results show that, when compared with solution-annealed specimens, the tensile flow behavior of the sodium-exposed specimens is characterized by a higher strain-hardening rate, which decreases rapidly with an increase in flow stress. The values of the saturation stress for uniform elongation predicted from the Voce model are higher for the sodium-exposed specimens than for those in the solution-annealed condition at strain rates $<$ or approximately $5 \times 10^{-5}\ s^{-1}$ and lower for strain rates $>$ or approximately $5 \times 10^{-5}\ s^{-1}$. Metallographic examination of the fracture surfaces shows a transition from a complete ductile fracture to a partial intergranular failure as the strain rate decreases. Carburization of the specimens appears to inhibit the intergranular failure.

57187 Viscoplastic bending of copper—nickel and steel tubing. Frick, T.M. (Westinghouse Electric Corp., Waltz Mills, PA); Neubert, V.H. *J. Eng. Mater. Technol.;* **99**: No. 4, 387-392(Oct 1977).

Experimental data for dynamically loaded viscoplastic beams with a tubular cross section where elastic strains are a significant part of the total strain are obtained for two materials, 1020 steel and 70/30 copper-nickel alloy. Maximum strain rates are 0.78 and 1.89 s^{-1}, respectively. A successful experimental approach for obtaining dynamic data results which can be used in defining failure for optimal design are provided. A moment-curvature constitutive relation, including rate effects, is fitted to the data.

PHYSICAL PROPERTIES

57188 (AD—918032) **Integrated ablative and radiative heat shield panels and leading edges for high l/d reentry vehicles. Final technical report Jun 70—Aug 73.** Kiger, R.W. (General Dynamics Corp., San Diego, CA (USA). Convair Aerospace Div.). Sep 1973. Contract F33615-70-C-1304. 145p.

This program analytically and experimentally investigates the design and thermostructural performance of integrated ablative/radiative thermal protection systems in two phases: CONCEPT DEVELOPMENT AND FULL-SCALE PANEL DEVELOPMENT. In Phase I, the program includes the investigation, analysis, and test of sub-scale specimens and various design concepts to determine design values for the full-scale panels and leading edges. Phase II covers the design and fabrication of large-scale lower surface ablative panels and leading edges for integration on the AFFDL Hypersonic Aerospace Test Structure (HATS). A vehicle configuration, the FDL-5A, is furnished by the Air Force to serve as a basepoint for the analytical and experimental phases of the program. (Author, modified-PL)

57189 (COO—2315-12) **Competition between electron—electron and electron—phonon mechanisms in the electrical and thermal resistivities of simple metals.** Lawrence, W.E. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics). Aug 1977. Contract EY-76-S-02-2315. 7p. (CONF-770847—8). Dep. NTIS, PC A02/MF A01.

From 15. international thermal conductivity conference; Ottawa, Ontario, Canada (24 Aug 1977).

The use of the thermal and electrical resistivities as tools for studying the electron-electron interaction in metals is discussed. Focus is on the simple and noble metals. (GHT)

57190 (COO—2679-22) **Possible temperature dependence of the activation energy for grain boundary diffusion in metals.** Hwang, J.C.M.; Balluffi, R.W. (IBM Watson Research Center, Yorktown Heights, NY (USA); Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). May 1978. Contract EY-76-S-02-2679. 13p. Dep. NTIS, PC A02/MF A01.

The apparent activation energy for existing grain boundary diffusion data shows a tendency to decrease with decreasing tem-

perature. Such a decrease may conceivably be due to at least two causes: (1) The grain boundary diffusion must involve several different types of atomic jumps in the core region, each of which is characterized by a different activation energy. The resulting diffusion is then a weighted average over these jumps. As the temperature is lowered, the jump paths with higher activation energies become progressively "frozen out." If the paths are connected in a parallel arrangement (in analogy to an electrical circuit) the averaged effective activation energy decreases as the temperature is reduced. (2) Experimental results were obtained using polycrystalline samples containing a spectrum of different types of grain boundaries. The overall observed diffusion is, therefore, a weighted average over these boundaries. As the temperature is lowered, the boundaries with the higher activation energies become progressively frozen out and the averaged effective activation energy decreases. (GHT)

57191 Utilization of titanium sponge in H.T.G.R. Tone, H. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). *Chitaniumu Jirukoniumu;* **25**: No. 4, 167-178(Oct 1977). (In Japanese).

The high temperature, gas-cooled reactor (H.T.G.R.) uses helium as a coolant and graphite as both the moderator and the fuel tube material. At first sight, there should not be any problem concerning the compatibility of these materials in the H.T.G.R. core region where temperature exceeds 700°C, however, it is possible that the graphite core and other structural materials are oxidized by traces of impurities in the coolant. In large-power H.T.G.R., water inleakage from both heat exchangers and coolant circulation pumps will probably be the major source of impurity which will react with the graphite-producing H_2, CO and CO_2. In the near future, the nuclear heat of H.T.G.R. will be used as a major heat source for steel production and the chemical industry. For these purposes, it will be necessary to construct a reactor using a helium coolant of greater than 1000°C. Therefore, not only the development of refractory metals as structural materials but also an effective helium coolant purification system are the keys for H.T.G.R. construction. Recently, in the helium coolant purification system of H.T.G. Reactors, which have been developed in the several nations advanced in atomic reactors, titanium sponge is used very frequently to remove hydrogen gas as an impurity in helium coolant. Titanium sponge can absorb very large quantities of hydrogen and its absorption-capacity can be very easily controlled by controlling the temperature of the titanium sponge-since titanium hydride is formed by endothermic reaction. The titanium sponge trap is used also in OGL-1 (Oarai Gas Loop-1), helium coolant purification system for large scale irradiation apparatus which is used for nuclear fuels of H.T.G.R. This apparatus has been installed in the Japan Material Testing Reactor. In this report, the coolant purification system of H.T.G.R., OGL-1 and the experimental results of the titanium sponge trap are explained briefly.

57192 (HEDL-TME—78-47) **Thermophysical properties of ferrous structural alloys.** Moen, R.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1978. Contract EY-76-C-13-2170. 142p. AT.

Thermophysical properties data are presented for all ferrous structural alloys used in the construction of Code-stamped nuclear components and unfired pressure vessels. Properties include thermal diffusivity, thermal conductivity, specific heat, and thermal expansion (instantaneous, mean, and linear). Tables are provided for each material covering temperatures from room temperature 1700°F (927°C). Appended to the report are tables correlating nominal composition designations and Unified Numbering System (UNS) numbers with ASME specification numbers, and vice versa.

57193 (UCRL—13831) **Measurement of the electronic specific heats and the Debye temperatures in some critical metallic alloy glasses. Final report.** Massalski, T.B. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Metal Physics Lab.). 30 Oct 1977. Contract W-7405-ENG-48. 66p. Dep. NTIS, PC A04/MF A01.

Specific heat measurements between approximately 1.5 and 4.2°K are reported for four Pd-Si and three Pd-Si-Cu alloys. The compositions chosen for study covered the stable glass region in the Pd-Si-Cu system. Measurements were performed on relatively large samples (approximately 16 g) of spun amorphous ribbon. The electronic specific heat coefficient, γ, is shown to be composition dependent, and to possess a maximum when presented as a function of the electron per atom concentration, e/a.

57194 (UCRL—52493) **Equation of state and transport measurements on expanded liquid metals up to 8000°K and 0.4 GPa.** Hodgson, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1978. Contract W-7405-ENG-48. 220p. Dep. NTIS, PC A10/MF A01.

Thesis.

Equilibrium measurements of pressure, enthalpy, density, temperature and resistivity have been made on liquid lead, platinum, gold-copper, uranium, niobium, and niobium-hafnium at high temperatures and pressures. A unique method of determining sample temperatures from multi-channel fast radiation pyrometry has been developed and used to calculate temperatures between 1600 and 8000 K without definitive emissivity information. Pseudo-potential theory has been used to model the lead resistivity and equation of state measurements and t-matrix theory has been applied to the uranium resistivity data.

57195 (Y/DA—7750) **Ultrasonic measurement of elastic constants at temperatures from 20 to 1100°C.** Donsbach, D.L.; Moyer, M.W. (Oak Ridge Y-12 Plant, TN (USA)). 1978. Contract W-7405-ENG-26. 40p. (CONF-780650—1). Dep. NTIS, PC A03/MF A01.

From 1. symposium on ultrasonic materials characterization; Gaithersburg, MD, USA (7 Jun 1978).

Acoustic techniques developed to allow determination of the elastic moduli of structural materials of interest to the Liquid Metal Fast Breeder Reactor and the High Temperature Gas Reactor programs are described. Measurements of the elastic moduli of a number of different materials were performed at temperatures from 20 to 1100°C. A two-step process was required to complete the measurements. First, the acoustic velocities were accurately measured using bulk samples at room temperature. Wire samples were then used to obtain elevated-temperature measurements by using a magnetostrictive transducer and an automatic data acquisition system. A computer was used to calculate the moduli and plot the data. A detailed summary has been made of the sources of error and a calculation of the precision of the measurements is given.

57196 Diffusion studies of Au through electroplated Pt films by Auger electron spectroscopy. McGuire, G.E.; Wisseman, W.R.; Holloway, P.H. (Texas Instruments Incorporated, Dallas, Texas 75222). *J. Vac. Sci. Technol.;* **15**: No. 5, 1701-1705(Sep 1978).

Diffusion of gold through thin films of electroplated platinum was studied using Auger electron spectroscopy. Platinum is widely used for the Schottky barrier metallization on GaAs IMPATT and varactor diodes with gold being used to contact the platinum. The effects of gold diffusion through platinum into the active semiconductor region could lead to long term reliability problems for diodes operated at elevated temperatures. Diffusion anneals in the temperature range from 750 to 900 K were carried out in an ultrahigh vacuum system while the surface sensitivity of Auger spectroscopy was utilized to monitor surface compositional changes. A grain boundary mechanism is proposed for the diffusion of Au through the 0.55-μm electroplated Pt films. The effective grain boundary diffusion constant for Au in the thin Pt films, D/sub b/=0.18 exp (-1.65 eV/kT) cm^2/s, was determined by a time-of-penetration test which accounts for bulk diffusion. This diffusion coefficient differs from others in the literature due to K and Sb impurities in the grain boundaries.

57197 Electron-phonon contribution to electrical resistivity and superconducting "p-wave" transition temperature of Pd. Pinski, F.J.; Allen, P.B.; Butler, W.H. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Phys. Rev. Lett.;* **41**: No. 6, 431-434(7 Aug 1978).

We present first-principles calculations of the electron-phonon parameters which govern transport and superconductivity in Pd. Our calculated resistivity is in good agreement with experiment. The s-wave" coupling constant (or mass enhancement) is 0.41 and the "p-wave" coupling constant is 0.002, making the existence of observable electron-phonon-induced "p-wave" pairing in Pd very doubtful.

57198 Evidence for valence fluctuations in CeAs. Weaver, H.T.; Schirber, J.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B;* **18**: No. 2, 973-976(15 Jul 1978).

Anomalous temperature and pressure dependences for the ^{75}As Knight shift in CeAs are interpreted within the framework of Hirst's model for fluctuating valence. A 30-K-wide peak in the density of states, located 85 K below E/sub F/, is inferred from the analysis. The area under the peak represents 1% of the Ce^{3+} valence, but due to the nature of the hyperfine interaction this is less than the actual number of electrons which would be involved in the fluctuation from Ce^{3+} to Ce^{4+}.

57199 Hysteresis in the flux flow characteristics of a type II superconductor associated with the presence of normal metal presence of normal metal precipitates. Habbal, F.; Joiner, W.C.H. (Physics Department, University of Cincinnati, Ohio). *J. Low Temp. Phys.;* **32**: No. 1, 239-261(1 Jul 1978).

Unusual history-dependent flux flow properties are observed in a Pb/sub 0.871/Sn/sub 0.129/ alloy as tin predicpitates from solution at room temperature. We find that the critical currents and flux flow curves depend upon the field history, the current history, and the orientational history of the sample. Two volume pinning force curves are observed with different force magnitudes and field locations of the force peak, depending upon whether the field is

cycled to high fields or zero field before the force is measured. Flux flow noise measurements in these samples yield very low noise, consistent with our recent model, which predicts low noise in samples with closely spaced pinning centers that interrupt the flux motion. The experimental results are explained in terms of the formation of a nonequilibrium flux line lattice in the presence of precipitates, and the response of such a lattice to current, field, and orientational changes.

57200 Effect of transition metal impurities on the superconducting critical temperature. Role of the s—d Coulomb interaction. Kravtsov, V.E.; Mal'shukov, A.G. (Institute of Spectroscopy, Academy of Sciences of the USSR, Moscow Province, Podolsk District). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 25-29(Jan 1978).

A study is made of the effect of the s—d Coulomb interaction on the superconducting temperature T/sub c/ of alloys with a low concentration of nonmagnetic transition metal impurities. The strong interaatomic repulsion of electrons with opposite spins is treated exactly and the s—d Coulomb interaction is taken into account in the parquet approximation in the limit Γ/εvery-much-less-than1, μvery-much-less-than1, and μlnω/sub p//ε~1, where Γ is the width of the impurity level; μ is the s—d Coulomb interaction constant; and ω/sub p/ is the plasma frequency of conduction electrons. It is shown that, in this limit, the s—d Coulomb interaction leads to a lowering of T/sub c/. The change in T/sub c/ is calculated in an approximation linear in the impurity concentration.

57201 Instability of the current in Cd/sub x/Hg/sub 1-x/Te subjected to a magnetic field. Gel'mont, B.L.; Golubev, V.G.; Ivanov-Omskii, V.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 47-48(Jan 1978).

An investigation was made of current-voltage characteristics of n-type Cd/sub x/Hg/sub 1-x/Te solid solutions of compositions $0.2<x<0.33$ (n/sub 4.2/≃2×10^5 cm^{-3}, μ→/sub 4.2/ ≃10^4—10^5 $cm^2xV^{-1}xsec^{-1}$) and of their photoresponse to the 29.97 μ wavelength of an H_2O vapor laser. The measurements were carried out in magnetic fields upt to 55 kOe at temperatures of T=4.2 and 1.6°K. It was found that the current-voltage characteristics were S-shaped and that noise oscillations of ~10—1000 Hz frequency were generated. The results were attributed to an overheating instability under the phonon bottleneck conditions.

57202 Increase of the superconductivity critical temperature T/sub c/ due to the size effect. Bogomolov, V.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 82-84(Jan 1978).

Analysis of the increase of T/sub c/ in metal films, sandwiches and filaments, and of the effect of compression on T/sub c/, leads to a hypothesis that different groups of metals have the same reaction to external interaction. It is deduced that the low-frequency peaks in the phonon density of states may lower T/sub c/ by a factor of 2—3 in films and filaments, and that the elimination of these peaks by making sandwiches with "isotropic" phonon properties may increase T/sub c/ for filaments to 30—40°K.

57203 Superconductivity of indium antimonide at high pressures. Il'ina, M.A.; Itskevich, E.S. (Institute of High-Pressure Physics, Academy of Sciences of the USSR, Akademgorodok, Podolsk District, Moscow Province). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 167-169(Jan 1978).

The pressure dependence of the transition temperature of n- and p-type InSb is studied in the range 30—80 kbar.(AIP)

57204 Microcontact spectroscopy of electron—phonon interaction in zinc and cadmium. Yanson, I.K. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 726-733(Dec 1977).

The nonlinear current—voltage characteristics of microscopic (d≃10—100 A) zinc and cadmium point contacts are measured at 1.5°K. It is shown that the second derivatives of the characteristics are proportional to the density of phonon states and permit the maxima in the phonon spectrum to be located more precisely. The microcontact spectra display seven features: five maxima at eV=7.6 +- 0.2, 10.1 +- 15.2 +- 0.7, 19.5 +- 1.0 and 23.3 +- 0.5 MeV for zinc and 4.8 +- 0.3, 6.6 +- 0.1, 10.5 +- 0.3, 13.3 +- 0.8 and 17.0 +- 0.5 MeV for cadmium as well as two additional maxima, observed more rarely, at eV=12.5 and 26.5 MeV for zinc and 8.5 and 20 MeV for cadmium. All of these values are fairly consistent with the position of the singular points partialω/partialq=0 on the phonon dispersion curves. Slight energy shifts and redistribution of line strength observed in the spectra of different samples are interpreted as being due to the different orientation of crystallites in the region of the contact. The effect of temperature on the spectral linewidth is studied and an empirical method is proposed for taking account of the background observed in the spectra of most contacts.

57205 Width of the ferromagnetic resonance line in single crystal gadolinium. Anders, A.G.; Belozorov, D.P.; Spol'nik, A.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 738-739(Dec 1977).

The behavior of ferromagnetic resonance line width in single crystal gadolinium is studied over the temperature range 77—340 °K. The role of various line broadening mechanisms in this temperature interval is studied. It is shown that in imperfect crystals dislocations play a significant in line broadening, and that dislocation broadening role is well described by theory. X-ray structural analysis data are used to find the temperature dependence of the ferromagnetic relaxation constant.

57206 Critical magnetic fields of distorted gallium films. Lazarev, V.G.; Semenenko, E.E.; Tutov, V.I. (Khar'kov Physicotechnical Institute of the Academy of Sciences of the Ukrainian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 749-750(Dec 1977).

The paper presents results of an investigation of critical magnetic fields of gallium films freshly condensed on a substrate cooled to the temperature of liquid helium and also annealed to 60°K. The thickness of the film is ~150 A. It is found that the transverse critical magnetic field in freshly condensed films is ~10^5 Oe for T/sub K/~8.3 °K, i.e., H/sub K/1(O) ~1.2×10^4 T/sub K/. The function H/sub K/perpendicular(T) deviates considerably from a linear law; this is probably connected with the multiphase nature of the gallium films. The values of the critical magnetic field after annealing to 60 °K are slightly reduced, and the superconducting transition curve in this case is more smeared.

57207 Magnetic phase transformations and the magnetocaloric effect in single crystals of Tb-Y alloys. Nikitin, S.A.; Andreenko, A.S.; Chuprikov, G.E.; Posyado, V.P. (Moscow State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 119-122(Jul 1977).

The magnetic phase transitions in single crystals of Tb and Tb-Y alloys are investigated with the aid of the magnetocaloric effect, using the results of the magnetization and magnetostriction measurements. The energy contributions to the entropy change that occurs in the helical antiferromagnetic-ferromagnetic transition are found on the basis of a thermodynamic analysis of the experimental data. It is established that the destruction of the helical structure in this transition occurs largely as a result of gigantic magnetostrictive deformations.

57208 Resistivity of shock-compressed ytterbium. Pavlovskii, M.N. *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 122-126(Jul 1977).

Results are reported of an experimental investigation of the electric conductivity of shock-compressed ytterbium in the pressure range up to 220 kbar. It is shown that up to ~30 kbar the resistivity of ytterbium increases with pressure, and the ytterbium acquires semiconducting properties. At pressures on the order of 20 to 30 kbar the ytterbium undergoes a phase transition and becomes metallic again. Further increase of the shock-loading amplitude leads, at 80—150 kbar, to a sharp increase of the ytterbium resistivity, thus attesting to still another transition due to a realignment of the electron structure, a transition not heretofore observed under static compression conditions. The temporal characteristics of the aforementioned transitions were measured under actual shock-loading conditions. It is shown that raising the temperature and increasing the intensity of the shear deformations accelerates the transitions and decreases the values of the corresponding critical pressures.

57209 Magnetic breakdown in cadmium. Ventsel', V.A.; Voronov, O.A.; Rudnev, A.V. (Institute of High-Pressure Physics). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 127-132(Jul 1977).

The effective masses and the Dingle factor for all the oscillations in the (1010) and (1120) planes were determined by measuring, in pulsed magnetic fields up to 150 kOe, the dependence of the oscillation amplitudes in the de Haas—van Alphen effect on the temperature and on the magnetic field. An anomalous angular dependence of the Dingle factor was observed for the Dingle factor at the frequency F/sub gamma/3/ and is attributed to magnetic breakdown. The areas and positions in k-space of the extremal magnetic-breakdown orbits, the parameters v/sub parallel/ and v/sub perpendicular/ at the breakdown points, the gap Δ between the first and second Brilluoin zone at the breakdown points are all calculated. The experimental data are used to estimate the gap Δ. A possible interpretation, based on magnetic breakdown, is offered for the oscillation frequency f/sub chi/.

57210 Photoemission from noble metals and adsorbates using synchrotron radiation. Shirley, D.A.; STOEHR, J.; WEHNER, P.S.; WILLIAMS, R.S.; APAI, G. (CALIFORNIA UNIV., BERKELEY (USA). LAWRENCE BERKELEY LAB.). *Phys. Scr.;* **16**: No. 5, 398-413(1977).

From Conference on electron spectroscopy; Uppsala, Sweden (9 - 12 May 1977).

With the advent of synchrotron radiation in the 32-280 eV range at the Stanford Synchrotron Radiation Project, it has become possible to elucidate the transition from ultraviolet to X-ray-induced photoemission. This has accomplished by studies of noble metals. Polycrystalline copper shows a valence-band (VB) profile that approaches the X-ray induced shape at hγ approximately 100 eV. In polycrystalline silver, the 4d cross section follows the atomic curve, with a reversal of VB peak intensities near hγ=110 eV. Strongly anisotropic behavior is observed in copper single crystals, using angle-resolved photoemission (ARP). Normal ARP spectra from Cu(100), (110), and (111) crystals follow the band dispersion through the Brillouin Zone, including a dramatic resonance between the Fermi level (Esub(F)) and 2 eV binding energy for hγ=43-52 eV. High temperature and high photon energy studies demonstrate the importance of the Debye-Waller factor in photoemission leading to a breakdown of the direct transition model. In adsorption studies of CO on Ni and Pt, CO is shown to stand up with oxygen out. For Pt, electrons are found to flow from tsub(2g) orbitals near Esub(F) to CO, and the CO 1π and 5sigma binding energies are reversed relative to the gas phase. At higher photon energies, hγ=150 eV, the CO orbitals are very prominent on a Pt substrate.

57211 (ORNL-tr—4652) **Investigation of the transverse thermomagnetic effect.** Genkins, N.M.; Priporova, G.P. Translated by S.D. Blalock Jr. from *Zh. Eksp. Teor. Fiz.;* **26**: No. 3, 323-326(1954). 6p. Dep. NTIS, PC A02/MF A01.

A qualitative investigation is made of the transverse thermomagnetic effect of low carbon steel. It is shown that the transverse thermomagnetic effect is proportional to the intensity of magnetization. In the range of fields of technical saturation, the transverse thermomagnetic effect does not change with the field. In fields of lower intensity, hystereses of the transverse thermomagnetic effect exist.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 56367, 56368, 56679, 56906, 57381, 57413, 57414, 57416, 57428, 57429, 57430, 57431, 57432, 57433, 58083

57212 (AD-A—049848) **Alloy corrosion: fundamental studies of dissolution and passivity of alloys and compounds. Interim report, 1 March 1976—28 February 1977.** Lumsden, J.B.; Staehle, R.W. (Ohio State Univ. Research Foundation, Columbus (USA)). 5 Dec 1977. Contract N00014-75-C-0665. 33p. (OSURF—784131-2). NTIS PC A03/MF A01.

The effects of Si additions to Fe on the stability of the passive film have been investigated over the pH range from 0 to 10. Silicon, in concentrations below 14.5%, decreased the stability of the film. In sulfate solutions the passive current density was up to an order of magnitude less for the Fe-14.5 Si alloy relative to the Fe-8 Si alloy; the active peak decreased three orders of magnitude. In 0.1 N HCl, Fe-14.5 Si had a passive region. There was no passive zone for Fe, Fe-3 Si, or Fe-8 Si alloys in this solution. Surface analysis techniques indicate that the abrupt change in stability with the addition of 14.5% Si is not the result of an SiO_2 film on the surface.

57213 (BMFT-FB-K—77-13) **Friction and wear behavior of bearing materials and protective layers with regard to their application possibilities in water cooled nuclear reactors.** Hofmann, P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1977. 75p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

Friction, wear and corrosion resistance of several alloys were determined. Austenitic and ferritic stainless steels and wear-resistant coatings of Fe, Ni and Co alloys were all tested at temperatures of 20, 300 and 320°C. The stainless steels investigated showed adhesive wear even with the smallest surface loads. Most of the wear-resistant coatings had no satisfactory corrosion resistance. On the other hand, Everit 55 (Fe alloy with chromium carbide) under sliding conditions had good wear and corrosion results comparable to Stellite 6. The interface stainless steel Everit or stainless steel Stellite showed behavior intermediate between the interfaces SS-steel/SS-steel and Stellite/Stellite.

57214 **Feedwater line corrosion.** Brown, J.; McSweeny, P. (Ontario Hydro (Canada)). *Arch. Energiewirtsch.;* **32**: No. 1, 13-21(Jan 1978). (In German).

The report describes the results obtained with the first part of a programme to determine the concentration of corrosion products transported into the fossil- or nuclear-fired steam generators in every phase of operation, start-up, or shutdown. The general objective of the project was the development of practical recommendations for the introduction and implementation of corrosion control techniques in existing and future power plants.

57215 **Optimum quality assured. Corrosion protection of C steel parts for nuclear power plants in Germany.** Doell, G. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). *Energie;* **30**: No. 1, 21-24(Jan 1978). (In German).

Although there are as yet no special DIN standards for corrosion protection in nuclear power plants, quality is already well assured in this field. In some cases, existing DIN standards are applied to the coating materials used in nuclear power plants; in other cases where there are no DIN standards, special standards are being prepared. Of these, the recommendations by Kraftwerk UNION are already being used in practice.

57216 **Stainless steels in boiling water reactors. Corrosion problems and possible solutions.** Combrade, P.; Desestret, A.; Leroy, F. (Societe Creusot-Loire, 75 - Paris (France)); Coriou, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service d'Etude de la Corrosion et d'Electrochimie). *Mater. Tech.;* **8**: No. 9, 561-578(1977). (In French).

From 2. Colloquium on special steels and nuclear energy; Paris, France (14 - 15 Dec 1976).

In boiling water reactors, the heat-carrying water may have an up to 0.1 or even 0.2 ppm oxygen content, which can make it highly agressive at operating temperature for stainless steels subject to high physical stresses. Several metallurgical solutions can be considered, and in particular the use of stainless steels having a mixed austenitic-ferritic structure or of standard austenitic steels (18.10 or 18.10 Mo, such as AISI 304 and 316) with carefully controlled carbon and alloy element contents. The behavior of these steels during prolonged tests in water at 288°C with a 30 and even 100 ppm oxygen content turned out to be quite satisfactory.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 57026, 57027, 57180, 57302, 57814

57217 (BNL-NCS—50681, pp 29-35) **Materials damage studies.** Goland, A.N. (Brookhaven National Lab., Upton, NY). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The discussion of radiation damage studies for materials include the objectives, status of research, recommendations for dosimetry reactions, cross sections, reference spectra, sensitivity studies, special purpose fields, and charged-particle irradiations. 2 references. (JFP)

57218 (BNL-NCS—50681, pp 361-372) **Initial damage rates in Nb, V, and Mo from 30 MeV d-Be neutrons.** Guinan, M.W.; Violet, C.E. (Lawrence Livermore Lab., CA). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Changes in electrical resistivity in liquid helium temperature have been used to monitor the production of damage in dilute alloys of Nb, V, and Mo irradiated with high energy neutrons. The neutrons were produced at the University of California of California, Davis cyclotron by the reaction of 30 MeV deuterons on a thick beryllium target. Damage rates are compared to those produced at the Livermore rotating target neutron source. The relative damage production rates are in agreement with predictions based on damage energy calculations.

57219 (CONF-780722—1) **In-reactor deformation and fracture of austenitic stainless steels.** Bloom, E.E.; Wolfer, W.G. (Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1978. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

An experimental technique for determining in-reactor fracture strain was developed and demonstrated. Differential swelling between a sample holder and a test specimen with a lower swelling rate produced uniaxial deformation. In-reactor deformations of 0.7 to 2.1% were achieved in type 304 stainless steel previously irradiated to fluences up to 8.8×10^{25} n/m² without fracture. These strains are significantly higher than found in postirradiation creep-rupture tests on similar samples. From the measured strain values and published irradiation creep data and correlations, the stress levels during the irradiation were calculated. On the basis of previous postirradiation creep-rupture results, many of the samples that did not fail would be predicted to fail. Thus we conclude that the in-reactor rupture life is longer than predicted by postirradiation tests. Strain in a fractured sample was estimated to be less than 3.8%, and the in-reactor fractures were intergranular—the same fracture mode as found in postirradiation tests. Irradiation creep may relax stresses at crack tips and sliding boundaries, thus retarding the initiation and/or growth of cracks and leading to longer rupture lives in-reactor. However, the very high ductility or superplastic behavior predicted by the strain rate sensitivity of irradiation creep is not achieved because of the

eventual interruption of the deformation process by grain boundary fracture.

57220 (ECN—36) **Damage cross section library (DAMSIG77).** Zijp, W.L.; Appelman, K.H.; Nolthenius, H.J.; Rieffe, H.Ch. (Stichting Energieonderzoek Centrum Nederland, Petten). Feb 1978. 51p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The damage cross sections of various materials are converted to a data format, which can be used as library for the program SAND-II. The materials available in this library are graphite, stainless steel, aluminium, silicium, chromium, iron, nickel, copper, zirconium, molybdenum, tungsten, vanadium and niobium. A number of these materials have more than one cross section set, originating from different evaluations. Cross sections for some activation reactions, commonly used to determine thermal and fast neutron fluences have been included too. Moreover, also some artificial cross sections are introduced in this library which can be used to derive values for some physical quantities which may characterize neutron spectra.

57221 (HEDL-SA—1335) **Computer simulation and damage function analysis.** Doran, D.G.; Simons, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1977. Contract EY-76-C-14-2170. 18p. (CONF-771109—107). Dep. NTIS, MF A01.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

Portions of document are illegible.

Neutron damage to structural materials is generally sensitive to neutron energy. Because the test spectra in which radiation effects data are obtained are generally different from the design spectra to which components are to be exposed, a procedure was developed to take spectrum differences into account in correlating and applying test data. This procedure is described. (GHT)

57222 **Radiation-induced flux pinning in type II superconductors.** Freyhardt, H.C. (Institut fuer Metallphysik and Sonderforschungsbereich, University of Goettingen, Germany). *J. Low Temp. Phys.;* **32**: No. 1, 101-219(1 Jul 1978).

In monocyrstalline foils of oxygen-doped niobium and niobium—zirconium alloys, statistically distributed or regularly arranged voids were created during irradiation with high-energy $^{58}Ni^{+}$ ions (3.5 MeV, up to 8.1 x 10^{16} ions/cm^2) at temperatures between 750 and 900°C. The voids exhibit a strong interaction with flux lines, which was determined from measurements of the (anisotropic) critical currents as a function of transverse magnetic field, temperature, and defect geometry. The experimentally determined volume pinning forces obey scaling laws and lead to elementary interaction forces between voids and fluxoids that are larger than theoretical values calculated for various possible mechanisms of interaction. The validity of the statistical summation of elementary forces is discussed.

57223 **Pulsed irradiation: annealing and accumulation of defects.** Dienes, G.J. (Brookhaven National Lab., Upton, N.Y. (USA)). *Radiat. Eff.;* **36**: No. 1, 101-109(Apr 1978).

Simple defect production and annealing processes during pulsed irradiation were investigated. Exponential decay to fixed sinks and bimolecular recombination were handled analytically but computer calculations were needed when both modes of annealing were operative simultaneously. The defect concentrations reach steady state after a large number of pulse cycles and these steady state values were compared with the steady state values produced during continuous irradiation using the time average production rate. The maximum defect concentrations, attained at the end of the irradiation pulse, are always higher than those produced by the comparable continuous irradiation. The opposite is the case for the minimum concentrations reached at the end of the annealing pulse. The defect concentrations averaged over the pulse cycle are generally lower, while the averaged squares of the concentrations are higher than those produced by the comparable continuous irradiation.

57224 **Influence of pre-exposure to radiation on high-temperature phase transformations of the alloy Cu—Al.** Ibragimov, S.S.; Melikhov, V.D.; Kiryushin, V.P. (Institute of Nuclear Physics, Academy of Sciences of the Kazan SSR, Alma-Ata). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 2, 133-134(Feb 1978).

A Cu-Al alloy with a 11.47 wt.% Al content was irradiated with neutrons. The effect of the radiation on the microhardness of the sample was studied.

CERAMICS, CERMETS, AND REFRACTORIES

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 57228, 57229

57225 (MLM—2531(OP)) **Consolidated Al/Cu_2O thermites.** Haws, L.D.; Kelly, M.D.; Mohler, J.N.; Latkin, A. (Mound Facility, Miamisburg, OH (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract EY-76-C-04-0053. 17p. (CONF-780706—7). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

Processes were developed at Mound Facility to produce high density Al/Cu_2O thermite composites. Consolidation of the precursor thermite powders produces efficient chemical heat sources that are safe to handle, are machineable, and generate minimum gas pressure upon reaction. This paper describes some of the ignition characteristics and performance features of selected consolidated thermite systems. In addition, an inexpensive low energy input system for igniting consolidated thermites is described.

STRUCTURE AND PHASE STUDIES

57226 (SAND—78-0250) **Theoretical studies of hydrogen in metals: current status and further prospects.** Switendick, A.C. (Sandia Labs., Albuquerque, NM (USA)). Apr 1978. Contract EY-76-C-04-0789. 10p. Dep. NTIS, MF A01.

Portions of document are illegible.

Electronic band structure studies of metal-hydrogen systems have demonstrated the existence of large metal-hydrogen and hydrogen-hydrogen interactions. These interactions lead to the formation of stable hydride phases. Factors governing this interaction are investigated for various different structures. Possible new directions for theoretical research are indicated.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 56334

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 56340

57227 (IS-T—762) **Effects of microstructure on the elastic properties of selected Ta_2O_5—Eu_2O_3 compositions.** Malarkey, C.J. (Ames Lab., IA (USA)). Jun 1977. Contract W-7405-ENG-82. 69p. Dep. NTIS, PC A04/MF A01.

Thesis.

Elastic properties and internal friction of selected compositions of tantala-doped monoclinic europia were studied at temperatures up to 1500°C using the sonic resonance technique. Unit cell parameters between 25C and 1000°C for monoclinic Eu_2O_3 were calculated from high temperature x-ray diffractometer data. Large-grained monoclinic specimens having less than 6.0 Ta cation percent substitution exhibited anomalous elastic behavior when thermally cycled. Compositions above this addition level exhibited linear elastic behavior. Internal friction values also varied abnormally with grain size, composition, and temperature. The anomalous behavior was attributed to microcracking caused by thermal expansion anisotropies. The critical grain size was found to be approximately 14 μm. The high temperature diffractometry measurements supported the postulate that the grain coarsening effect associated with sintered monoclinic Eu_2O_3 is the controlling factor for microcracking.

57228 (SAND—78-8503) **Determination of palladium—aluminum reaction propagation rates and temperatures.** Birnbaum, M.R. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

Three experimental techniques—thermometry, framing and streaking photography, and dynamic radiography—were employed to determine the reaction propagation rates and temperatures of various mixtures of palladium and aluminum. Pellets of 94/6, 90/10, and 80/20 Pd/Al mixtures with an average density of 5 x 10^3 kg/m^3 were prepared and tested in an insulating sleeve. Pretest radiography was used to determine the density in the Pd/Al pellet as well as to observe any anomalies in the pressing of the pellet that might affect the performance of the pyrotechnic. Propagation rates were found to be approximately 40 mm/s for 94/6 and approximately 500 mm/s for 90/10 and 80/20. The burn temperatures were found to be approximately 1400°C for 94/6 and approximately 2400°C for 90/10 and 80/20. One-dimensional model calculations qualitatively compare well with experimental results.

57229 (UCRL—81168) **Beryllium fluoride optical glasses: preparation and properties.** Cline, C.F.; Weber, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 May 1977. Contract W-7405-ENG-48. 37p. (CONF-780720—1). Dep. NTIS, PC A03/MF A01.

From 1. otto schott symposium; Jena, D.D.R., F.R. Germany (10 Jul 1978).

Preparation, physical and optical properties, and Nd laser parameters of several beryllium fluoride glasses are reported. These

glasses have the smallest refractive index nonlinearity measured for solids.

57230 AES studies of chemical shift and beam effect on molybdenum oxides. Lin, T.T.; Lichtman, D. (Laboratory for Surface Studies and Department of Physics, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). *J. Vac. Sci. Technol.;* **15**: No. 5, 1689-1694(Sep 1978).

Auger electron spectroscopy (AES) studies of the MNN spectra of MoO_3, MoO_2, oxidized Mo foil, and Mo (100) single crystal reveal the splitting of the Auger transition peaks which involve valence electrons. The splitting of these transition peaks is attributed to the altered valence-band density of states which illustrates the existence of two major oxidation states in the specimen. The additional state is caused either through surface oxidation or beam-induced reduction. Based on the M/sub 4,5/N/sub 2,3/V transition peak, the measurement shows the chemical shift to be 5 eV for Mo^{6+} and 1 eV for Mo^{4+}. The reduction of the oxygen Auger peak-to-peak height (APPH) with a simultaneous enhancement of the Mo APPH and sample coloration change in the beam-irradiated area has been observed during electron bombardment of oxide specimens. The observable changes indicate the occurence of beam-induced decomposition and the preferential loss of oxygen from the surface. The electron bombardment mainly causes the reduction of MoO_3 to MoO_2. The efficiency of further reduction to the elemental metal state is low as compared to the reduction process from Mo^{6+} to Mo^{4+}. Comparison of predicted Auger intensities, based on the contribution to the total Auger intensity from each atomic plane, with the experimental observations confirms the formation of a Mo^{4+}-rich surface layer on a beam-irradiated specimen.

57231 Proton magnetic relaxation in lanthanum hydrides. Kashaev, R.S.; Gil'manov, A.N.; Gubaidullin, F.F.; Kost, M.E. (Physicotechnical Institute, Kazan Branch of the Academy of Sciences of the USSR, Kazan). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 1-4(Jan 1978).

The pulse NMR method at 16 MHZ was used to investigate proton magnetic relaxation in lanthanum hydrides LaH/sub 2.08plus-or-minus0.03/ and LaH/sub 2.98plus-or-minus0.03/, whose compositions were on opposite sides of a metal—semiconductor transition. The investigation was carried out in the temperature range from -180°C to +400°C. An analysis of the temperature dependences of the spin—lattice T_1 and spin—spin T_2 proton relaxation times established that the main contribution to the relaxation in these hydrides was made by modulation of the dipole—dipole interactions as a result of hopping diffusion of hydrogen. A considerable contribution was also made by the interaction of protons with conduction electrons. In the case of LaH/sub 2.08/ the product T/sub 1e/T was 74 +- 5 sec.°K, which was typical of metallic conduction. In the LaH/sub 2.98/ case the interaction of protons with electrons did not obey the Korringa relationship but was described by the equation T/sub 1e/ =C (1/T: 1/T/sub c/)/sup 1/2/ (where $C=2.3\times10^{-2}$ sec°K/sup 1/2/ and T/sub c/=650°K) and obeyed a law typical of semiconductors but with a correction for T/sub c/. The results supported the anion model of lanthanum trihydride, which (together with the proton model) explained well the transition of lanthanum hydride to the semiconductor state when the hydrogen/metal ratio reached H/Me=3.

57232 High-field effects in vanadium pentoxide single crystals. Ivon, A.I.; Chernenko, I.M. (Ukraine and Russia Reunion Tercentenary State University, Dnepropetrovsk). *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 130-131(Jan 1978).

Deviations from Ohm's law were found in measurements of the conductivity of V_2Os in strong electric fields applied along various crystallographic directions. (AIP)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 56334

57233 (DOE/NASA/2593—78/1) **Reactions of yttria-stabilized zirconia with oxides and sulfates of various elements.** Zaplatynsky, I. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1978. Contract EF-77-A-01-2593. 18p. (NASA-TM—78942). Dep. NTIS, PC A02/MF A01.

Zirconia-based coatings are being evaluated as thermal barriers for air-cooled gas-turbine components. The reactions between partially stabilized zirconia, containing 8-weight-percent yttria, and oxides and sulfates of various elements were studied at 1200°, 1300°, and 1400°C for times to 800, 400, and 200 hours, respectively. These oxides and sulfates represent impurities and additives potentially present in gas turbine fuels or impurities in the turbine combustion air as well as the elements of the substrate alloys in contact with zirconia. Based on the results, these compounds can be classified in four groups: compounds which did not react with zirconia (Na_2SO_4, K_2SO_4, Cr_2O_3, Al_2O_3 and NiO); compounds that reacted completely with both zirconia phases (CaO, BaO, and $BaSO_4$); compounds that reacted preferentially with monoclinic zirconia (Na_2O, K_2O, CoO, Fe_2O_3, MgO, SiO_2, and ZnO); and compounds that reacted preferentially with cubic zirconia (V_2O_5, P_2O_5). The phase compositions of the reaction products were determined by x-ray diffraction analysis. 1 figure, 1 table.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 57217

57234 (KFK—2523) **FR2-loop experimental series 5. Irradiation, post-irradiation examination and analysis of the FCMI.** Mueller-Lyda, I. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Schneller Brueter). Oct 1977. 40p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

In the FR2-Loop-experiment series 5 the plastic cladding tube diametral strain of UO_2-PuO_2 test pins was examined after load-following operation. The pin design was different from the SNR 300-specification with respect to a strong FCMI (Fuel-Cladding Mechanical Interaction). The irradiation was carried out in a high number of single cycles (300-500 W/cm linear power, 1-600 h duration) with a following diameter measurement. It turned out that within the attained burnup range (< 2%) no considerable diameter increases occurred, even after very rough cycling, except one case with a very special power- and temperature history. The analysis of the operating conditions of this pin shows an important influence of the fuel temperature during the reduced power phase. The ideas about FCMI during load-following operations are tested with the experimental results and model calculations.

COMPOSITE MATERIALS

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 57415

PHYSICAL PROPERTIES

57235 Effective thermal diffusivity for a multimaterial composite laminate. Schimmel, W.P. Jr. (Sandia Labs., Albuquerque, NM); Beck, J.V.; Donaldson, A.B. *J. Heat Transfer;* **99**: No. 3, 466-470(Aug 1977).

The development of an "effective thermal diffusivity" which can be used to estimate the temperature response at the insulated rear surface of a multilayer composite to a step in temperature at the front surface of the composite is discussed. An example is considered using the effective value along with the mathematics of a single layer problem, and results thereof are compared with both those of an exact solution, and those which use an effective diffusivity computed from a "lumped" parameter model.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 57217

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

57236 (Y—2123) **Characterization of Kevlar-49 yarn.** Thompson, W.F.; Powell, G.L.; Lever, W.E. (Oak Ridge Y-12 Plant, TN (USA)). Jul 1978. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

A study was made to determine the variability in Dupont's 380-denier Kevlar-49 yarn. Both in-spool and spool-to-spool variations in tensile strength, cross-sectional area, and chemical composition were determined for one lot of material.

STRUCTURE AND PHASE STUDIES

57237 (SAND—78-0761C) **Fourier transform infrared analysis of plasma polymerized 2-vinylpyridine thin films.** Bieg, K.W.; Ottesen, D.K. (Sandia Labs., Albuquerque, NM (USA); Sandia Labs., Livermore, CA (USA)). 1978. Contract EY-76-C-04-0789. 11p. (CONF-780902—9). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

As a preliminary step toward the study of electrical and aging properties of thin-film capacitors made from plasma polymerized 2-vinylpyridine thin films, the chemical structure of these films deposited under a variety of plasma reactor conditions was investigated. Fourier transform infrared spectroscopy was found to be a useful

technique for the characterization of plasma polymerized organic thin films (1,000 to 40,000 A) deposited on aluminum substrates. Further, this technique was used to observe variations in the chemical structure of poly (2-vinylpyridine) films as a function of reactor conditions (pressure, power, and carrier gas). 7 figures, 2 tables. (RWR)

57238 Computer simulation of the dynamics of a single polymer chain. Ceperley, D.; Kalos, M.H.; Lebowitz, J.L. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Phys. Rev. Lett.;* **41**: No. 5, 313-316(31 Jul 1978).

We have carried out computer simulations of the dynamics of a model polymer chain in a solvent. We find that the structure function scales for different chain sizes N as a function of q = kN/sup ν/ with $\nu = 0.6 \cong$ exponent for the radius of gyration. Furthermore, S (q) ~ q/sup -5/3/ over a wide range, as predicted by Edwards. Time-dependent correlation function appear to scale as tN/sup α/, with $\alpha \cong 2\nu + 1$. The time-displaced structure function is of the form S (kN/sup ν/, tN/sup α/).

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 57236

PHYSICAL PROPERTIES

57239 (SAND—78-0412C) **Room temperature moisture kinetics of Kevlar 49 fabric/epoxy laminates.** Allred, R.E.; Lindrose, A.M. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 17p. (CONF-780347—1). Dep. NTIS, PC A02/MF A01.

From Symposium on composite materials) testing and design; New Orleans, LA, USA (20 Mar 1978).

Hygrothermal effects can significantly influence the failure behavior of high performance epoxy-based composites. As such, it is necessary to determine, for one, the moisture diffusion rates in the composite's principal axes so that moisture densities and distributions can be estimated for life-cycle exposures. In this study, moisture diffusion coefficients are determined for quasiisotropic Kevlar 49 181-style fabric reinforced Narmco 5208 epoxy laminates, and for the epoxy and fabric components individually. A microbalance technique is employed to continuously monitor the percentage weight gain of specimens exposed to 76 percent relative humidity at room temperature. The anisotropy of moisture diffusivity in the composite laminates is determined by use of a slope ratio (absorption vs time) technique and specimens of appropriate geometry. Results show that moisture diffuses in the laminate plane (6.6×10^{-8} cm²/sec) two orders of magnitude faster than through the thickness (1.9×10^{-10} cm²/sec). These values compare to a resin diffusivity of 7.1×10^{-10} cm²/sec. It is speculated that the rapid inplane diffusion is due to the preferential diffusion of moisture in the filament along its length.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 57217, 57290

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 57054

57240 (AD-A—049697) **Preparation of rare earth doped laser materials. Annual summary report, 1 November 1976—1 November 1977.** Belt, R.F.; Drafall, L. (Litton Systems, Inc., Morris Plains, NJ (USA). Airtron Div.). Jan 1978. Contract N00014-76-C-0770. 26p. NTIS PC A03/MF A01.

This report describes the preparation of specific host materials doped with either Ce(3+) or Pr(3+). The materials were prepared by either a solid-phase sintering, crystallization from a high-temperature flux, or direct growth by the Czochralski method from a melt. Both the amount of dopant and particularly the valence state of cerium were important variables in attempting to control fluorescence. Samples were prepared for both spectral investigations and possible laser schemes in the blue-green region. Growth atmospheres and conditions were adjusted to yield the maximum amount of Ce(3+) in single crystals. YAG:Ce(3+) and $YAlO_3$:Pr were prepared in fabricated forms of disks, rectangular rods or cylindrical rods. These crystals were then examined at other laboratories.

57241 (BMFT-FB-K—77-11) **Improved manufacture of electrographite powder.** Schneider, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1977. 16p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

It is known that the required graphitization temperature can be reduced by adding catalysts in definite concentrations and applying definite residence times. The intention of this work is to operate on a technical scale at lower graphitization temperatures, i.e. at lower cost, using the catalyst that proved to be most suitable for the intended purpose. Aluminium carbide Al_4C_3 was experimentally determined in a continuous vertical graphitization furnace to be the most suitable catalyst. By transferring these results to the technical scale of the Acheson furnace, a temperature decrease of 500°C could be achieved at a catalyst concentration of 0.5%. The graphitized powder complies with the requested specifications. The work is continued within the outlines of the PNP-program.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 57250

57242 (CONF-770698—3) **Structure of borate glasses by Raman spectroscopy.** White, W.B.; Brawer, S.A.; Furukawa, T.; McCarthy, G.J. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). 1977. Contract EG-77-C-02-4245. 16p. Dep. NTIS, PC A02/MF A01.

From Conference on boron in glass and glass ceramics; Alfred, NY, USA (5 Jun 1977).

Raman spectra of the alkali borate glasses are presented with emphasis on the implications of detailed frequency shifts and line shapes. The results are interpreted on a rather complicated three-level hierarchy of glass structures which include boron-oxygen polyhedra, topologically closed rings of polyhedra, and larger scale interconnected clusters of alkali-rich and alkali-poor structures. Both the model and the argument are deliberately vague. The borate glasses appear to be highly disordered materials with a size scale such that no presently available tool gives a really clear view of the structural detail.

PROPERTIES

REFER ALSO TO CITATION(S) 56379, 56763, 56766, 56767, 56768, 56769, 57242, 57935

57243 (BDX—613-1880(Rev.)) **Shelf life aging of DC-302 silicone molding compound.** McFarland, J.W. (Bendix Corp., Kansas City, MO (USA)). Aug 1978. Contract EY-76-C-04-0613. 15p. Dep. NTIS, PC A02/MF A01.

DC-302 silicone molding compound (Dow Corning Corporation) was packaged 10 different ways, stored at three different temperatures, and tested for spiral flow periodically for 8 months. The material was very stable at 5°C and fairly stable at 24°C. It was sensitive to heat, however, and was unstable at 55°C. Samples that were stored for 12 months at 5°C showed no significant change in physical properties.

57244 Channeling analysis of stacking defects in epitaxial Si layers. Campisano, S.U.; Foti, G.; Rimini, E. (Catania Univ. (Italy). Istituto di Struttura della Materia); Picraux, S.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). *Nucl. Instrum. Methods;* **149**: No. 1, 371-376(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

The channeling effect technique has been applied to investigate dechanneling by stacking defects in heteroepitaxially grown silicon. Ion backscattering was performed on 0.9 μm Si layers grown on sapphire as a function of beam energy (1.1-2.5 MeV He^+), projectile ion (He^+, D^+) and crystal direction ((100), (111), (112), (113)). Transmission electron microscopy analysis revealed the presence of a high density of stacking faults and twin lamellae. A model based on the new interior surfaces presented by such stacking defects is used to calculate the dechanneling cross section, and the disorder profiles are obtained from the experimental dechanneled fractions in terms of displaced rows per unit volume. Direct backscattering of channeled particles from the defects is neglected since the dechanneling cross section per row is about one order of magnitude larger than that per displaced atom. The resulting defect depth distributions are independent of beam energy and projectile ion, and give improved quantitative agreement with previous studies. The application of channeling to stacking-defect measurements requires a minimum density of approximately 10^{15} displaced rows/cm².

57245 (MLM—2550(OP)) **Electrical resistivity of TiH/sub x/$KClO_4$.** White, K.; Reed, J.W.; Love, C.M.; Holy, J.A.; Glaub, J.E. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 21p. (CONF-780706—16). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

Various factors affecting the electrical resistivity of the pyrotechnic pressed powder TiH/sub x//$KClO_4$, which is sensitive to hot wire ignition yet quite spark insensitive, were evaluated. The electrical resistivity of the TiH/sub x/ (x = 0.19-1.9, pressing pressure 10 to 160 kpsi) and TiH/sub x//$KClO_4$ (x = 0.19-1.9, pressing pressure 10 and 20 kpsi) were correlated with their pressing

pressure, stoichiometry, and powder surface area. The resistivity increases with x and with surface area, and it decreases nonlinearly with pressing pressure. In addition, the effect of electrostatic discharge pulsing on resistivity was tested for various samples of TiH/sub x/ and TiH/sub x//$KClO_4$ pressed pellets. For the higher resistivity pellets (rho greater than 1 Ω x cm), a decrease in resistivity was observed. For low resistivity pellets (rho less than or equal to 1 Ω x cm), no change in resistivity was observed, yet an increase in current flowing through the pellets occurred. The effect of temperature on resistivity for TiH/sub x/ pressed pellets from below liquid nitrogen temperature to 500 K was also studied.

57246 (TID—28410) **Theoretical studies of excess electrons in fluids: structure and electron transfer. Progress report, June 1, 1977—February 15, 1978.** Kestner, N.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry). 1978. Contract EG-77-S-05-5399. 36p. Dep. NTIS, PC A03/MF A01.

Research in electron transfer reactions, calculations on trapped electrons in molten alkali halide salts, and long range medium effects on the structure of the trapped electron in polar fluids is described. (GHT)

57247 Electric polarization behavior of MgO : Li^+ crystals upon quenching from above 1400 K. Eisenberg, D.J.; Cain, L.S.; Lee, K.H.; Crawford, J.H. Jr. (Department of Physics and Astronomy, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514). *Appl. Phys. Lett.;* **33**: No. 6, 479-481(15 Sep 1978).

Crystals of Li^+-doped MgO which have been quenched from temperatures in excess of 1400 K exhibit an extraordinarily large polarization in an electric field, and the temperature dependence of the relaxation time of this polarization, as measured by both dc (thermal depolarization) and ac (loss tangent versus frequency) methods, indicates a relaxation activation energy of 0.6—0.73 eV, which is consistent with the ionization energy of $[Li]^0$ centers. This polarization behavior is to be expected for small semiconductor inclusions (regions of high $[Li]^0$ center density embedded in a dielectric) and supports the "microgalaxy" model of Chen et al. to account for stable $[Li]^0$ centers in annealed and quenched MgO : Li^+ crystals.

57248 Effect of twins on dechanneling a charged particle beam. Foti, G.; Csepregi, L.; Kennedy, E.F.; Mayer, J.W. (California Inst. of Tech., Pasadena (USA)); Pronko, P.P.; Rechtin, M.D. (Argonne National Lab., Ill. (USA)). *Nucl. Instrum. Methods;* **149**: No. 1, 381-385(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

Implanted and annealed (111) Si has been used to evaluate the influence of twin structures (extended defects) on dechanneling rates. Transmission electron microscopy measurements showed the presence of twins lying along [111] planes. Calculations and experimental measurements show that the primary contribution of twinned regions is an increase in the dechanneling rate. These results demonstrate that the standard method of analysis for isolated scattering centers imbedded in a perfect lattice tends to overestimate the amount of disorder at depth if twinned regions are present.

57249 Adsorption on inorganic materials. VII. Hydrous tin oxide and SnO_2-filled carbon. Ho, P.C.; Nelson, F.; Kraus, K.A. (Oak Ridge National Lab., TN). *J. Chromatogr.;* **147**: 263-269(1978).

An adsorbent based on "filling" the macropores of activated carbon with tin oxide was prepared and characterized. This material, as well as hydrous tin oxide, has an unusually high selectivity for lithium permitting its separation from the other alkali metals. This selectivity is not shown by a number of other hydrous oxides, such as those of Al(III), Fe(III), Zr(IV), and Nb(V).

57250 Fundamentals on the agglomerate model and its relation to the physical properties of pyrocarbon. Linke, J.; Koizlik, K.; Nickel, H. (Kernforshungsanlage, Juelich, Ger.). *Nucl. Technol.;* **35**: No. 2, 257-262(Sep 1977).

The deposition mechanism of pyrocarbon (PyC) from the gas phase has been interpreted in terms of diverse models. The so-called droplet or agglomerate model shows a high degree of reliability. It quantitatively describes the growth mechanism of agglomerates, initiated by chemical and physical processes, taking place in the gas phase. The morphology of the originating agglomerates, i.e., their final size as well as their composition of different components are deduced, and these results correlate to the physical properties of the resulting PyC material.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 56763

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 57217, 57220, 57414, 58083

57251 Influence of structure defects on the quantum efficiency of light-emitting diodes made of compensated GaAs:Si. Karas', V.I.; Lomako, V.M.; Novoselov, A.M.; Tkachev, V.D. (Scientific-Research Institute of Applied Physics Problems at the V. I. Lenin Belorussian State University, Minsk). *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 3, 244-246(Mar 1978).

A high quantum efficiency and a long lifetime in light-emitting diodes made of strongly compensated GaAs:Si cannot be explained by suppression of nonradiative recombination channels. It is suggested that the high quantum efficiency is associated with a low concentration of nonradiative recombination centers and the long lifetime is due to the low density of carriers in the bands, which is a consequence of the strong compensation.

57252 Electrical conductivity of silicon made amorphous by bombardment with very large ion doses. Mashin, A.I.; Tetel'baum, D.I.; Khokhlov, A.F. (Physicotechnical Research Institute at the N. I. Lobachevski State University, Gorko). *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 3, 253-255(Mar 1978).

Amorphous silicon layers were formed by irradiation of silicon single crystals with Ne^+ and Ar^+ ions in doses of (2—3) x 10^{17} and 6 x 10^{16} cm^{-2}, respectively. The energy of the Ne^+ ions was 40 keV and that of the Ar^+ ions was 50 keV. It was found that the electrical conductivity σ of the amorphous silicon varied nonmonotonically with depth. At a depth of ~100 A there was an abrupt change in σ, similar to that across a p-n junction. At the amorphous layer—single crystal interface there was another abrupt change in the conductivity. The layers formed in this way had electrical conductivity which was extremely high for amorphous silicon. In particular, in a thin surface layer (~100 A), the conductivity was $\sigma \approx 12 \Omega^{-1} x cm^{-1}$. The nonmonotonic variation of σ with depth was attributed to an inhomogenous distribution of the paramagnetic centers in the layer. The high electrical conductivity was well correlated with a higher concentration of such centers (defects). The most probable conduction mechanism was the conduction between states localized near the Fermi level. The width of the localized-states band was estimated to be 0.2 eV.

CHEMISTRY

57253 Electron attachment to van der Waals polymers of carbon dioxide and nitrous oxide. Klots, C.E.; Compton, R.N. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **69**: No. 4, 1636-1643(15 Aug 1978).

Negative ions formed by electron attachment to carbon dioxide and nitrous oxide, expanded through a sonic nozzle, are reported. In each case the dominant ions have the formula $O^-(M)$/sub n/, where M is the parent monomer. The appearance potential of O^- in each case indicates the absence of "hot bands." Ions with the formula $(CO_2)^-$/sub n/, with n> or =2, evidently formed by evaporative electron attachment, seem to be stable with respect to autodetachment. The "three-body" mechanism for attachment of thermal electrons to nitrous oxide and oxygen is discussed.

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 56395

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 56333

57254 (BNWL-SA—6263) **Sampling and measurement of long-lived radionuclides in environmental samples.** Brauer, F.P.; Goles, R.W.; Kaye, J.H.; Rieck, H.G. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 22p. (CONF-771113—15). Dep. NTIS, PC A02/MF A01.

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The volatile and semivolatile long-lived man-made radionuclides ^3H, ^{14}C, ^{79}Se, ^{85}Kr, ^{99}Tc, ^{129}I, ^{135}Cs, and ^{137}Cs are of concern in operation of nuclear facilities because they are difficult and expensive to contain and once emitted to the environment they become permanent ecological constituents with both local and global distributions. Species-selective sampling and analytical methods (radiochemical, neutron activation, and mass spectrometric) have been developed for many of these nuclides with sensitivities well below those required for radiation protection. These sampling and analytical methods have been applied to the measurement of current environmental levels of some of the more ecologically important radionuclides. The detection and tracing of long-lived

radionuclides is being conducted in order to establish base-line values and to study environmental behavior. This paper describes detection and measurement techniques and summarizes current measurement results.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 57616

57255 (TREE—1116, pp 161-162) **Determination of manganese content in aqueous solutions.** Reeder, S.D.; Smith, J.R. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

The three analytical methods used in the hydrogen-to-manganese cross-section ratio measurement were: volumetric determination of manganese, gravimetric analysis of manganous sulfate; and densimetric determination of manganous sulfate. (LK)

57256 **Determination of total mercury in coal and organic matter with minimal risk of external contamination.** Gardner, D. *Anal. Chim. Acta;* **93**: 291-293(1 Oct 1977).

A wet oxidation method is described that can be used to determine mercury in samples, such as coal, that have a high percentage of organic matter. The technique minimizes possible errors from atmospheric mercury contamination, incomplete sample oxidation and retention of mercury by acid-insoluble matter. The complete analysis takes a maximum of 24 h for coal. The absolute detection limit of the method is 5 ng: optimum measurements are obtained between 20 and 100 ng.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 57254, 57493

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 56617, 57254, 57616

57257 (SAND—78-8232) **Raman and infrared spectra of pollucite.** Hartwig, C.M.; Ottesen, D.K. (Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-76-C-04-0789. 37p. Dep. NTIS, PC A03/MF A01.

Raman light scattering, infrared reflection, and infrared absorption spectra are reported for the mineral pollucite and other cesium aluminosilicate formulations of interest to the beneficial use program of Sandia Laboratories. In addition, Raman spectra of crystals of a pure-phase pollucite are presented. Assignment of the active normal modes is made; a resonance at 200 cm^{-1} is tentatively assigned to a Cs cage mode; the remaining resonances are assigned to oxygen stretching vibrations of the Al-0 and Si-0 bonds, external vibrations of the aluminosilicate framework, and to more complex vibrations involving all of the atoms of the crystal. It is shown that by using a reference crystalline spectrum, oher cesium aluminosilicate structures can be identified as polycrystalline in nature with a makeup similar to pollucite. Structural alterations (broken bonds) as well as state changes (crystalline to amorphous) can also be ascertained by Raman spectroscopy. Water is found only in mineral pollucite, where it exists as a monomer, hydrogen-bonded to oxygen atoms that form its cage. Satisfactory results were obtained from a range of materials; black to milky to clear in appearance.

57258 **Simple method for obtaining x-ray photoelectron spectra of species in liquid solution.** Avanzino, S.C.; Jolly, W.L. (Univ. of California, Berkeley). *J. Am. Chem. Soc.;* **100**: No. 7, 2228-2230(29 Mar 1978).

Because of a previously reported observation at high quality x-ray, photoelectron spectra can be readily obtained for compounds dissolved in glycerin, a method was developed for converting aqueous solutions into glycerin solutions which give good spectra of the solute. The N 1s spectra of a series of nitrogen-containing salts and the S 2p spectrum of a solution of sodium thiosulfate were obtained. The core binding energies and line widths of nitrogen compounds are tabulated. The spectrum of the thiosulfate is given. (JSR)

57259 **Current and potential applications of inductively coupled plasma (ICP)-atomic emission spectroscopy (AES) in the exploration, mining, and processing of materials.** Fassel, V.A. (Ames Lab., IA). *Pure Appl. Chem.;* **49**: 1533-1545(1977).

The first papers describing the potential advantages of using inductively coupled plasmas as vaporization-atomization-excitation sources for the atomic emission determination of the elements appeared in the literature approximately ten years ago. During the elapsed decade, continuing studies in a relatively small number of laboratories have led to striking advances in the scope of application of this analytical concept. With state of the art systems, it is now possible to determine all of the metals, metalloids, noble gases, and hydrogen at the major, minor, trace, and ultratrace level in a viable practical manner. In principle, all of these elements can be detected and determined simultaneously or sequentially under a single set of operating conditions. In this review the formation and the properties of these plasmas are summarized and the present capabilities of ICP-AES with reference to such figures of merit as powers of detection, simultaneous multielement capability, applicability to the analysis of nicroliter or microgram samples, interelement effects, applicability to the direct excitation of liquids, solids, and gases, cost, accuracy, precision and dynamic range are reviewed. 9 figures, 3 tables, 41 references.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 56611

57260 (RFP—2756) **Extraction chemistry of some bidentate organophosphorus compounds.** Martella, L.L.; Navratil, J.D.; Santiago, W.F. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 17p. (CONF-780696—1). Dep. NTIS, PC A02/MF A01.

From 4. biennial Rocky Mountain meeting; Boulder, CO, USA (5 Jun 1978).

The extraction chemistry of methylenediphosphonates, carbamoylphosphonates, and carbamoylmethylenephosphonates has been investigated. The bidentate organophosphorus compounds extract actinides strongly, extract lanthanides, iron, gallium, molybdenum, titanium, vanadium, and zirconium partially, and do not extract most other elements from 5 to 7 M nitric acid. The properties of the extractants and extraction mechanisms are discussed. The effect of complexing agents on the extraction of actinides and lanthanides is also presented.

57261 **Solvent extraction studies of lead using Alamine 336 and Aliquat 336-S.** McDonald, C.; Mahayni, M.M.; Kanjo, M. (Texas Southern Univ., Houston). *Sep. Sci. Technol.;* **13**: No. 5, 429-437(1978).

New solvent extraction systems have been developed for the removal of lead ions from aqueous chloride solutions using the high-molecular-weight amines, Alamine 336 and Aliquat 336-S. The lead ions can be extracted with better than 80 percent efficiency using equal volumes of either 5 percent Alamine 336 or 5 percent Aliquat 336-S. The extractions are simple and rapid. The extracted lead can be stripped in both cases using EDTA.

57262 **Investigation into americium separation from residues of irradiated nuclear fuel fluorination with the LiF-NaF and LiF-CaF_2 eutectic melts.** Shishkov, Yu.D.; Khomyakov, V.I.; Galkin, N.P. *Radiokhimiya;* **19**: No. 4, 555-559(1977). (In Russian).

From All-union conference on transplutonium elements chemistry (americium, curium, berkelium, californium); Dimitrovgrad, USSR (29 Jun - 1 Jul 1976).

The distribution of cerium, lanthanum, neodymium, praseodymium, samarium, europium, gadolinium fluorides, contained in a mixture, in the LiF-NaF and LiF-CaF_2 melts of eutectic composition in the presence of barium, strontium, calcium, zinc, nickel, iron, aluminium, chromium, copper and silicon oxide additives has been determined. The behavior of americium contained in the mixture of rare-earth fluorides has been studied when treated with the LiF-NaF and LiF-CaF_2 melts of eutectic composition in the presence of oxide additives at the following ratio: melt: $[(REL)F_3+AmF_3]$: Mesub(n)Osub(m) = 15:5:1, where Me = Ba, Sr, Ca, Zn, Fe, Ni, Cr, Al, Cu, Si. For most of the additives introduced into the LiF-NaF melt the coefficient of separation ranges between 0.5 and 2.0, it is only 5.4 in the presence of an Al_2O_3 additive. In the case of the LiF-CaF_2 melt the maximum coefficients are possible in the presence of iron, zinc, aluminium and silicon oxides, while the minimum coefficients (Ksub(s) = 0.42) in the presence of barium oxide. The availability, apart from lanthanum fluorides, of the fluorides of other rare earths produces a substantial effect on the extraction of americium from the fluoride mixture.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 56587, 57233, 57281

57263 (AD-A—049865) **Emission spectrum of the nu 3 band of Sf 6 at 1780°K. Technical report.** Bott, J.F. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 20 Jan 1978. Contract F04701-77-C-0078. 14p. (TR—0078(3940-02)-2). NTIS PC A02/MF A01.

The emission spectrum of the nu3 band of SF6 at 1780°K is measured in a shock tube. At this high temperature, the emission peaks at a frequency of 907/cm (11.02 mu); at room temperature, the

band has a peak intensity at 948/cm. Lyman and Nowak observed similar but proportionately smaller shifts of the spectral maximum to lower frequencies at temperatures between 400 and 800°K. A knowledge of the high-temperature spectral distribution of the nu3 band is important for the design and interpretation of isotope separation experiments in which SF6 is dissociated by selective multiphoton absorption of CO_2 laser photons.

57264 (IS-T—800) **Electron transfer reactions of macrocyclic compounds of cobalt.** Heckman, R.A. (Iowa State Univ. of Science and Technology, Ames (USA)). Aug 1978. Contract W-7405-ENG-82. 205p. Dep. NTIS, PC A10/MF A01.

Thesis.

The kinetics and mechanisms of reduction of H_2O_2, Br_2, and I_2 by various macrocyclic tetraaza complexes of cobalt(II), including Vitamin B/sub 12r/, were studied. The synthetic macrocycles studied were all 14-membered rings which varied in the degree of unsaturation,substitution of methyl groups on the periphery of the ring, and substitution within the ring itself. Scavenging experiments demonstrated that the reductions of H_2O_2 produce free hydroxyl radicals only in the case of Co([14]ane)$^{2+}$ but with none of the others. In the latter instances apparently H_2O_2 simultaneously oxidizes the metal center and the ligand. The reductions of Br_2 and I_2 produce an aquohalocobalt(III) product for all reductants (except B/sub 12r/ + Br_2, which was complicated by bromination of the corrin ring). The mechanism of halogen reduction was found to involve rate-limiting inner-sphere electron transfer from cobalt to halogen to produce a dihalide anion coordinated to the cobalt center. This intermediate subsequently decomposes in rapid reactions to halocobalt(III) and halogen atom species or reacts with another cobalt(II) center to give two molecules of halocobalt(III). The reductions of halomethylcobaloximes and related compounds and diamminecobaloxime by Cr^{2+} were also studied. The reaction was found to be biphasic in all cases with the reaction products being halomethane (for the halomethylcobaloximes), Co^{2+} (in less than 100 percent yield), a Cr(III)-dimethylglyoxime species, a small amount of free $dmgH_2$, and a highly-charged species containing both cobalt and chromium. The first-stage reaction occurs with a stoichiometry of 1:1 producing an intermediate with an absorption maximum at 460 nm for all starting reagents. The results were interpreted in terms of inner-sphere coordination of the cobaloxime to the Cr(II) and electron transfer through the oxime N-O bond.

57265 (ORO—1797-81) **Solution-solid state conformational dependence in a rigid-ligand lanthanide complex. Preparation and structure of sodium[diaquobis(benzene-1,2-dioxydiacetato)lanthanate(III)] tetrahydrate.** Kerfoot, H.B.; Choppin, G.R.; Kistenmacher, T.J. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry; Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemistry). 1978. Contract EY-76-S-05-1797. 21p. Dep. NTIS, PC A02/MF A01.

The preparation and crystal structure of sodium[diaquobis(benzene-1,2-dioxydiacetato)lanthanate(III)] tetrahydrate, $Na[La(H_2O)_2(C_{10}H_8O_6)_2]$. $4H_2O$ are reported. Crystals obtained from aqueous solution are triclinic, space group P anti 1, with a = 12.350(4)A, b = 12.760(3)A, c = 8.783(3)A, α = 101.54(2)°, β = 95.28(2)°, γ = 75.98(2)°, Z = 2, d/sub measd/ = 1.86(2) g cm^{-3}, d/sub calcd/ = 1.81 g cm^{-3}. Standard heavy-atom methods were employed in the structural solution. Full-matrix, least-squares refinement of the non-hydrogen atom parameters, based on 4337 counter-collected F_o's, led to a final R value of 0.041 and a final weighted R value of 0.054. The lanthanum ion is decacoordinate, with a primary coordination sphere comprised of two tetradentate benzene-1,2-dioxydiacetate ligands and two water molecules. The coordination polyhedron about the lanthanum ion approximates a s-bicapped square antiprism, with typical La-O separations. Individual sodium ions are hexacoordinate and inversion-related sodium coordination polyhedra together form a distorted, edge-shared bioctahedron. The novel aspect of the structure is the multiple bridging between the lanthanum and sodium ion coordination spheres, primarily through the benzene-1,2-dioxydiacetate ligands. The molecular conformation of the lanthanum complex observed in this structure does not duplicate that found in solution by NMR techniques. These conformational differences are attributable to interactions involving the coordinating sodium ion and other crystal packing forces not expected to be present in solution.

57266 (UCRL—52505) **Analysis of the Powder Diffraction File.** Snyder, R.L.; Johnson, Q.C.; Kahara, E.; Smith, G.S.; Nichols, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jun 1978. Contract W-7405-ENG-48. 64p. Dep. NTIS, PC A04/MF A01.

The International Centre for Powder Diffraction Data has compiled an extensive powder diffraction database available on magnetic tape. The database was evaluated to determine the type and quality of the information it contains, including an analysis of d-I pairs per pattern, symmetry, quality marks, Q values, and intensities for subfiles of known crystal class. In addition, nine functions were evaluated to assess pattern quality for cubic and triclinic data. This document presents a minimum amount of data analysis, but concentrates on the distribution and statistics. It also describes how these data were obtained.

57267 **Oxygen-17 magnetic resonance study of oxygen exchange between arsenite ion and solvent water.** Copenhafer, W.C.; Rieger, P.H. (Brown Univ., Providence). *J. Am. Chem. Soc.;* **100**: No. 12, 3776-3780(7 Jun 1978).

Oxygen-17 magnetic resonance spectra of aqueous solutions of sodium arsenite were measured for 0.6 < [As(III)] < 4.1 m, 10 < t < 90°C. Line broadening of the water resonance in the 40 to 90°C range gives the rate of oxygen exchange between $AsO(OH)_2^-$ and solvent water. Exchange takes place via a first-order pathway, ΔS_1/sup 2+/ = -120 +- 3 J K^{-1} mol^{-1}, ΔH_1/sup 2+/ = 25 +- 1 kJ mol^{-1}, and a pathway second-order in arsenite, ΔS_2/sup 2+/ = -102 +- J K^{-1} mol^{-1}, ΔH_2/sup 2+/ = 33 +- 4 kJ mol^{-1}. Rates were measured using solutions of pH approximately 10.2; exchange appears to be only slightly faster in solutions of lower pH.

57268 **Neutron diffraction study of $HFeCo_3(CO)_9(P(OCH_3)_3)_3$, a metal cluster complex with a triply bridging hydride ligand.** Teller, R.G.: Wilson, R.D.; McMullan, R.K.; Koetzle, T.F.; Bau, R. (Univ. of Southern California, Los Angeles). *J. Am. Chem. Soc.;* **100**: No. 10, 3071-3077(10 May 1978).

We wish to report the first accurate neutron diffraction study of a transition metal structure with a triply bridging hydride ligand, the cluster $HFeCo_3(CO)_9(P(OCH_3)_3)_3$. The compound crystallizes in the space group $P2_1/c$, Z = 4. The cell constants at 90 K are a = 15.957 (8) A, b = 10.611 (5) A_o c = 18.383 (9) A, β = 98.70 (2)°. The structure was refined, based on the measured intensities of 8229 reflections; the final discrepancy factors for all reflections are R/sub F^2/ = 0.087, R/sub wF^2/ = 0.066. The four metal atoms form a tetrahedron with the apical Fe atom additionally bonded to three terminal carbonyl groups. Each Co atom is further bonded to one terminal and two bridging carbonyl ligands, as well as one phosphite group and the hydride ligand. The hydride ligand is located outside the metal cluster, 0.978 (3) A from the Co_3 face. This result confirms that of an earlier x-ray investigation by Huie, Knobler, and Kaesz. The Co—H distances are 1.724 (3), 1.731 (3), and 1.728 (3) A, and Co—H—Co angles are 92.1 (1), 91.7 (1), and 91.5 (1)°.

57269 **Extended x-ray absorption fine structure studies of the hydrolytic polymerization of iron(III). I. Structural characterization of the μ-dihydroxo-octaaquodiiron(III) dimer.** Morrison, T.I. (Argonne National Lab., IL); Reis, A.H. Jr.; Knapp, G.S.; Fradin, F.Y.; Chen, H.; Klippert, T.E. *J. Am. Chem. Soc.;* **100**: No. 10, 3262-3264(10 May 1978).

Aqueous solutions of Fe(III) hydrolyze over a range of pH forming dimer and polymer complexes. The existence of the dihydroxo-bridged Fe(III) dimer μ-dihydroxo-octaaquodiiron $[(H_2O)_4Fe(OH)_2Fe(OH_2)_4]^{4+}$ (I) in low pH solutions has been postulated to be the predominant species. Structural data, based on the extended x-ray absorption fine structure, demonstrates the existence of the postulated dimer I. The structure is proposed in which each Fe(III) is octahedrally coordinated to two OH^- ligands and to four H_2O molecules. Bond angles were evaluated for the postulated planar ring. (JSR)

57270 **Process for the catalytic oxidation of hydrogen sulfide with sulfur dioxide.** Whelan, J.M. (to Univ. of Southern California). US Patent 4,062,932. 13 Dec 1977. Filed date 5 Aug 1976. 26p.

A process for the oxidation of hydrogen sulfide with sulfur dioxide to produce sulfur is described which comprises combining the hydrogen sulfide with a one-half molar equivalent of sulfur dioxide and passing the hydrogen sulfide-sulfur dioxide mixture over a ceramic catalyst of the following formula at a temperature between about 100° and about 800°C: W/sub k/X/sub n/J/sub (1-k-n)/ZO (3 +- m) where W is zirconium, tin or thorium, or a mixture thereof; X is an alkaline earth metal or mixture thereof; J is scandium, yttrium, a rare-earth element or mixture thereof; Z is a metal of the first transition series or a mixture thereof, at least 0.01% of said metal having an oxidation state other than +3; k is a number having a value of between 0 and about 0.01; m is a number having a value of from 0 to about 0.26; and n is a number having a value from 0 to about 0.51, provided when n has a value of 0, k has a value between 0 and about 0.05.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 56614

57271 **Excitation functions of slow proton transfer reactions involving negative ions.** Lifshitz, C.; Wu, R.L.C.; Tiernan, T.O. (Wright State Univ., Dayton, OH). *J. Am. Chem. Soc.;* **100**: No. 7, 2040-2048(29 Mar 1978).

Excitation functions were determined for a series of slow proton and deuteron transfer reactions involving negative ions using a tandem mass spectrometer. Some of the reactions observed, for

example, $ND_2^- + D_2 \rightarrow D^- + ND_3$, exhibit translational energy thresholds, even though they are exothermic. Other reactions, such as $CH_3COCH_2^- + CD_3COCD_3 \rightarrow CH_3COCH_2D + CD_3COCD_2^-$, exhibit a complex functional dependence of the cross section upon relative translational energy, which in turn is quite sensitive to the internal energy of the neutral reactant. Rate coefficients determined for these negative ion reactions in the present investigation are compared with analogous data previously reported for thermal energy reactants. The translational energy thresholds observed for several of the reactions are consistent with the existence of a potential energy barrier in the reaction coordinate between the reactants and products. It is demonstrated that the deconvoluted excitation function for the ND_2^-/D_2 reaction is of the form sigma varies as (E/sub rel/ — E_0)/sup 1/2//E/sub rel/, as required by theory, and that the translational energy threshold corresponds to the Arrhenius activation energy for this process.

57272 Crystal structure of 4-0-β-d-galactopyranosyl-l-rhamnitol. Takagi, S.; Jeffrey, G.A. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. B;* **B33**: 2377-2380(1977).

$C_{12}H_{24}O_{10}$, M/sub r/ = 328.32, monoclinic, $P2_1$, a = 5.279 (1), b = 12.204 (1), c = 11.725 (1) A, β = 99.70 (1)° [lambda(Cu K α_1) = 1.5405 A], V = 744.58 A^3, Z = 2, D/sub m/ = 1.466, D/sub x/ = 1.164 g cm^{-3}. The structure was solved with MULTAN and refined to $R(F_o^2) = 0.039$ for 1602 reflections. The galactopyranose ring is distorted $^4C_1$ and the conformation of the primary alcohol group is +sc (gauche-trans). The rhamnitol residue has the straight carbon chain conformation, except for the terminal methyl group. The β-glycosidic torsion angle is -71° and the glycosidic bond is short, 1.384 A. There is an intramolecular hydrogen bond between the two residues which links a terminal hydroxyl of the rhamnitol to the ring oxygen of the galactose. All the O atoms are involved in the hydrogen bonding which consists of separate finite and infinite chains.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 57237

57273 Dynamics of semidilute polymer solutions. Schaefer, D.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780902—2). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

This work confirms the salient features of the pseudogel model. The fundamental assumption that GAMMA scales has been verified as well as the M and K independence of GAMMA. The weakness of the model in failing to predict the shape of the correlation function and the scaling exponent x must lie either in an imprecise definition of the crossover concentration, c^*, or in an improper analysis of what is actually measured in the light scattering experiment. Indeed, comparison of the semidilute data here and the dilute results of King, et al., indicates that the entanglement concentration c^* scales as $c^{-1.4}$ in disagreement with the prediction of $c^{-0.8}$. Similar difficulties have been observed by Munch et al. in comparing c^* in different solvents.

57274 Ab initio studies of the relative energetics of glycine and its zwitterion. Tse, Y.C.; Newton, M.D.; Vishveshwara, S.; Pople, J.A. (Brookhaven National Lab., Upton, NY). *J. Am. Chem. Soc.;* **100**: No. 14, 4329-4331(5 Jul 1978).

Ab initio molecular orbital calculations using the 4-31G atomic orbital basis set have been carried out for various conformations of the glycine zwitterion. The equilibrium conformation based on standard bond lengths and bond angles is characterized by a planar framework involving an intramolecular NH...O hydrogen bond and lies 29 kcal/mol above the equilibrium conformation for the nonzwitterionic form, implying a hydration energy of approximately 50 kcal/mol for the gas-phase zwitterion. Examination of the energetics of intramolecular proton transfer indicates that the zwitterionic form is associated with a very shallow local minimum characterized by an elongated NH bond (1.075 A) and separated from the nonzwitterion by a very small barrier (approximately <0.5 kcal/mol). Thus the gas-phase zwitterion is not expected to have an observable lifetime, and it is not even clear that a vibrational state would exist within the local minimum which defines it.

57275 Isocyanide insertion reactions. The role of isocyanide insertions in the metal assisted hydrogenation of isocyanides. Adams, R.D.; Golembeski, N.M. (Yale Univ., New Haven). *J. Am. Chem. Soc.;* **100**: No. 14, 4622-4623(5 Jul 1978).

$H_2Os_3(CO)_{10}$ was reacted with phenyl isocyanide to form $H_2Os_3(CO)_{10}(CNC_6H_5)$, which upon refluxing loses 1 mol CO to form a new complex that is believed to be a possible intermediate in the phenyl isocyanide reduction process. The molecular structure of the last complex was determined. (DLC)

57276 Molybdenum enzyme model studies. Synthesis and structure of the oxo-bridged binuclear complex, μ-oxo-bis[oxo(2,2'-methyliminodiethanethiolato)molybdenum(V)], $Mo_2O_3[NCH_3(C_2H_4S)_2]_2$. Tsao, Y.Y.P.; Fritchie, C.J. Jr.; Levy, H.A. (Tulane Univ., New Orleans). *J. Am. Chem. Soc.;* **100**: No. 13, 4089-4095(21 Jun 1978).

The complex μ-oxo-bis[oxo(2,2'-methyliminodiethanethiolato)molybdenum(V)], $Mo_2O_3[NCH_3(C_2H_4S)_2]_2$, has been synthesized and its crystal structure has been determined from three-dimensional x-ray diffractometer data. The crystals are monoclinic, space group $P2_1/c$, with four molecules in a cell having parameters α = 14.849 (2), b = 7.956 (2), c = 15.861 (2) A, β = 90.97 (2)°, and Z = 4. Full-matrix least-squares refinement using 1488 observed and 54 unobserved intensities (Mo Kα radiation) has yielded a conventional R factor of 0.049. The asymmetric unit consists of halves of two independent molecules of $Mo_2O_3[NCH_3(C_2H_4S)_2]_2$ located on crystallographic centers of symmetry. Disorder of the three carbons around each nitrogen atom, representing alternate conformations of the chelate rings, has been found. The configuration of the molecule is that of two distorted trigonal bipyramids centrosymmetrically connected through the central, bridging oxygen. The terminal oxygen and two sulfur atoms of each half molecule form a trigonal plane, and the nitrogen atom is trans to the bridging oxygen atom. The average Mo—O(terminal), Mo—O(bridge), Mo—N, Mo—S bond distances are 1.667 (8), 1.858 (1), 2.233 (10), and 2.346 (3) A, respectively. This is the first known five-coordinate complex of the $Mo_2O_3^{4+}$ unit with a ligand containing sulfur. 6 tables, 5 figures, 37 references.

57277 Studies of the pH dependence of ^{13}C shifts and carbon-carbon coupling constants of [U-^{13}C]aspartic and -glutamic acids. London, R.E.; Walker, T.E.; Kollman, V.H.; Matwiyoff, N.A. (Los Alamos Scientific Lab., NM). *J. Am. Chem. Soc.;* **100**: No. 12, 3723-3729(7 Jun 1978).

^{13}C NMR studies of the chemical shifts and carbon—carbon spin—spin coupling constants of 90% [U-^{13}C]aspartic and -glutamic acids are reported. Effects of titration of the two carboxyl groups are separated computationally and the results compared with those for asparagine and glutamine, aspartate and glutamate containing peptides, and a series of amino-n-butyric acids. The results indicate that the carboxyl carbon shift resulting from titration of the carboxyl group is strongly dependent on its distance (number of bonds) from an amino group. Alternatively, remote methyl groups exhibit a much smaller titration induced shift than carboxyl groups in the corresponding position. Significant remote effects of pH titration on the one-bond carbon-carbon coupling are also observed, particularly for couplings involving the side-chain carboxyl carbons. These results are discussed in terms of polarization of the C—O bonds in response to titration of a remote carboxyl group. Values of ^3J/sub CC/ in asparate and glutamate indicate a strong conformational dependence. Rotamer populations predicted on the basis of the observed couplings and theoretical INDO calculations are in good agreement with values based on analysis of the ^3J/sub HH/ and ^3J/sub CH/ couplings. For a given conformation of glutamic acid, it is found that $^3J_{14}$ is considerably smaller than $^3J_{25}$. This result is consistent with obsrvations on a number of other ^{13}C-labeled amino acids. 5 figures, 4 tables.

57278 Acid-base properties of 1-methyl-1,4-dilhydroborabenzene, $CH_3BC_5H_6$. Sullivan, S.A.; Sandford, H.; Beauchamp, J.L.; Ashe, A.J. III. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **100**: No. 12, 3737-3742(7 Jun 1978).

Ion cyclotron resonance techniques are employed to determine the gas-phase Bronsted and Lewis acidities as well as the Bronsted basicity of 1-methyl-1,4-dihydroborabenzene, $CH_3BC_5H_6$. The ring proton is found to be highly acidic with $PA(CH_3BC_5H_5^-) = 337 +- 3$ kcal/mol. This acidity results from the formation of 6π electron aromatic anion $CH_3BC_5H_5^-$, which is isoelectronic with toluene. Both the Lewis acidity toward F^- as a reference base and the proton basicity of the parent molecule suggest that there is little interaction between the diene π system and the electron-deficient boron. This is further confirmed by the similarity of both negative and positive ion chemistry of the borabenzene to that of aliphatic boranes.

57279 Low spin manganocene and its novel anionic derivative. Synthesis and characterization of decamethylmanganocene complexes. Smart, J.C.; Robbins, J.L. (Univ. of California, Berkeley). *J. Am. Chem. Soc.;* **100**: No. 12, 3936-3937(7 Jun 1978).

Reaction of lithium pentamethylcyclopentadienide in THF with anhydrous $MnCl_2$ gave good yields of pure decamethylmanganocene (I) as air-sensitive, red-orange crystals. Magnetic susceptibility and other measurements indicate that I is a normal metallocene and is isostructural and isoelectronic with the

ferricenium ion. Its electronic configuration is S = ½. It could be reduced by sodium naphthalide to produce the decamethylmanganocene anion (II), which behaves as a strong one-electron reducing agent. Both I and II are inert toward ring exchange reactions, suggesting that the addition of five methyls to the cyclopentadienyl results in increased crystal field splitting in planar metallocenes. (DLC)

57280 Structural effects in solvolytic reactions. XXVI. A critical study of the effect of solvent on the exo:endo rate ratio in the solvolysis of 2-norbornyl derivatives. Evidence that the exo:endo rate ratio is not the result of K/sub Δ//K/sub s/ processes. Brown, H.C.; Ravindranathan, M.; Chloupek, F.J.; Rothberg, I. (Purdue Univ., West Lafayette, IN). *J. Am. Chem. Soc.;* **100**: No. 10, 3143-3149(10 May 1978).

The generally accepted position that the exo:endo rate ratio in the solvolysis of 2-norbornyl derivatives is the result of a k/sub Δ/ process for exo and a k/sub s/ process for endo was subjected to critical examination by investigating the exo:endo rate ratio as a function of solvent. These mesylates were synthesized, along with several representative derivatives (isopropyl, cyclopentyl, and cyclohexyl), and solvolyzed in pure water and in 60 percent aqueous acetone. The tosylates were solvolyzed in methanol and in formic acid. These data, as well as other data, including those for solvolysis in trifluoroacetic acid and hexafluoroisopropyl alcohol, were then subjected to critical examination. Over the entire range of solvents, log k/sub exo/ plots linearly against log k/sub endo/. This is not consistent with the usual interpretation that the solvolysis of the exo isomer involves a k/sub Δ/ process, insensitive to the nucleophilicity of the solvent, whereas the solvolysis of the endo isomer involves a k/sub s/ process, sensitive to the nucleophilicity of the solvent. The solvolysis of 2-adamantyl tosylate has been proposed as a representative k/sub c/ process. Both exo- and endo-norbornyl tosylates are nicely correlated with the rates of solvolysis of 2-adamantyl tosylates over the exceptionally wide range of solvents here examined. On the other hand, isopropyl, cyclopentyl, and cyclohexyl derivatives, postulated to involve k/sub s/ processes, are not so correlated. Clearly it is necessary to reconsider the previous interpretation of the solvolysis of endo-norbornyl derivatives as involving a k/sub s/ process and the exo:endo rate ratio as arising from the operation of k/sub Δ//k/sub s/ processes. The data are in better agreement with the solvolyses of both exo- and endo-norbornyl proceeding through processes that are essentially k/sub c/.

57281 Structure of starch-iodine. Teitelbaum, R.C.; Ruby, S.L.; Marks, T.J. (Northwestern Univ., Evanston, IL). *J. Am. Chem. Soc.;* **100**: No. 10, 3215-3217(10 May 1978).

It was previously shown that the combination of resonance Raman and iodine-129 Moessbauer spectroscopy, aided by studies of appropriately selected model compounds, can be used effectively to elucidate polyiodide structure in low-dimensional mixed valence materials. These techniques are applied to a study of the structure of starch-iodine. Unambiguous evidence is provided that the predominant polyiodide species within the amylose helix is I_5^-. (JSR)

ISOTOPE EFFECTS

57282 Carbon-14 and deuterium isotope effect during the [2 + 2] cycloaddition of diphenylketene to styrene. Collins, C.J. (Oak Ridge National Lab., TN); Benjamin, B.M.; Kabalka, G.W. *J. Am. Chem. Soc.;* **100**: No. 8, 2570-2571(12 Apr 1978).

In order to determine more about the isotope effects in the reaction of styrene with diphenylketene, $Ph^{14}CH = CH_2$, $PhCH = {}^{14}CH_2$, $Ph_2{}^{14}C = C = O$, and $Ph_2C = {}^{14}C = O$ were prepared and the $^{12}k/^{14}k$ measured for all four labelled species during the [2 + 2] addition. The cis and trans β-deuteriostyrene were also prepared and the /sup H/k//sup D/k values measured. The Bigeleisen-Mayer expression and the Fry-Sims relation on transition state structure were applied to the values obtained. The large $^{12}k/^{14}k$ value of 1.08 for /sup b/C and the small ^{14}C isotope effects at /sup a/C, /sup c/C, and /sup d/C were satisfactorily explained. The cis and trans /sup H/k//sup D/k values were identical within experimental error and in accord with the Streitwieser and Wolfberg-Stern calculations. The large (/sup H/k//sup D/k)/sub α/ value of 1.23 obtained could not be explained by these calculations and the special kind of hyperconjugation suggested by Baldwin and Kapecki is the best explanation available. (JSR)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 57271

57283 (COO—2451-4) Synthesis and biological incorporation of icons into macromolecules for NMR study. Final report, June 1, 1977—May 31, 1978. Grant, D.M.; Horton, W.J. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). 31 May 1978. Contract EY-76-S-02-2451. 14p. Dep. NTIS, PC A02/MF A01.

Carbon-13 enrichment synthesis and incorporation into three important biological systems have been carried out to provide materials for carbon-13 magnetic resonance studies. These systems include antibody-labeled haptens, labeled t-RNA and 5S-RNA molecules, and pyridoxal-5'-phosphate-labeled substrate mixtures. The synthesis phase of the work has been completed in all three cases, and the NMR studies completed on all but the antibody-hapten system which is still in process having been absorbed into other supported projects. Publications are now in preparation for the RNA and pyridoxal work. Preliminary results on the antibody-haptens work are encouraging as signals of antibody absorbed haptens have been observed but the results are still not yet conclusive.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 57263, 57602

57284 (COO—2807-13) Experimental investigation of the chemistry of excited states of rare gases. Second quarterly progress report, January 15, 1978—April 15, 1978. Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). May 1978. Contract EY-76-S-02-2807. 8p. Dep. NTIS, PC A02/MF A01.

Quenching of XeF(B) was studied using the steady-state photolysis of XeF_2 as the source of XeF(B). The XeF(C) state was observed, as well as the XeF(B) state, by using a very clean CO(A-X) resonance lamp to photolyze the XeF_2. Some of the preliminary data are discussed in this report. XeF(C) must be included in the kinetic scheme in order to understand the quenching of XeF^*. The pulsed laser induced fluorescence technique was used to measure radiative lifetimes and two-body quenching rate constants for the Xe(6p), Kr(5p) and Ne(3p) states. The transient digitizer, has been delivered and is being interfaced to the computer for signal averaging. Some of the work with Ne(3p) is mentioned in this report, as well as attempts to use a resonance lamp to give $Kr(^3P_1)$ which would be subsequently pumped with the pulsed laser.

57285 Differentiation of excited-state and biradical processes. Photochemistry of phenyl alkyl ketones in the presence of oxygen. Small, R.D. Jr.; Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **100**: No. 14, 4512-4519(5 Jul 1978).

The photochemistry of butyrophenone, valerophenone, γ-methylvalerophenone, and γ-phenylbutyrophenone was examined in the presence of oxygen. The use of triplet quenchers to tune the triplet lifetime to a conveniently short value allows the differentiation of triplet state and biradical reactions. Typically oxygen quenches the triplet state with rate constants of approximately 4 x $10^9\ M^{-1}\ s^{-1}$ and interacts with the biradicals with k_s approximately 7 x $10^9\ M^{-1}\ s^{-1}$. The interaction results in the formation of an intermediate which has as its main decay path the fragmentation to acetophenone, olefin and the regeneration of oxygen. About 75% of these intermediates decay giving type II products, while the other 25% yields a hydroperoxide. The ratio of products is probably controlled by spin statistical factors. Previous reports indicating that oxygen has no effect on the Norrish type II reaction are incorrect. 7 figures.

57286 Hydrogen abstraction by tert-butoxy radicals. A laser photolysis and electron spin resonance study. Paul, H.; Small, R.D. Jr.; Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **100**: No. 14, 4520-4527(5 Jul 1978).

The absolute rates of reaction of tert-butoxy radicals with a variety of organic substrates in solution have been determined using laser flash photolysis techniques. The relative rates agree well with values obtained from studies of hydrocarbon halogenation by tert-butyl hypochlorite or by ESR in the case of ethers and alcohols, while the absolute rates are considerably higher than suggested by previous reports. The absolute rate constants reaffirm the similarity between the behavior of alkoxy radicals and carbonyl triplets. Di-tert-butyl peroxide photosensitizes the decomposition of carbon tetrachloride into trichloromethyl radicals and chlorine atoms. The process involves excited peroxide molecules, rather than tert-butoxy radicals. 8 figures, 4 tables.

57287 Photoionization by green light in micellar solution. Thomas, J.K.; Piciulo, P. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **100**: No. 10, 3239-3240(10 May 1978).

The anionic micellar system sodium lauryl sulfate was used to produce the photoionization of 3-aminoperylene with green light at lambda = 530 nm. This is some 4.6 eV below the gas phase ionization potential and well into the solar spectrum. The data showed clearly the marked effect of micellar environment on the photoionization yield. The dependence of this yield on the intensity of the laser beam is illustrated. This is the first example of the one-photon ionization of a simple molecule with long wavelength light. The data illustrate possible designs for systems where light energy is converted to ion chemistry which may be later utilized to recover the stored energy. (JSR)

57288 Multiphoton dissociation of molecules with low power continuous wave infrared laser radiation. Woodin, R.L.; Bomse, D.S.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **100**: No. 10, 3248-3250(10 May 1978).

Recent studies have suggested the possibility of effecting dissociation processes with relatively low power CW lasers (several watts) provided that a molecule can be irradiated under nearly collision-free conditions for times approaching 1 sec. The establishment of such conditions and the observation of multiphoton dissociation processes are reported. The methodology applies techniques involving trapped ion cyclotron resonance spectroscopy and a CW CO_2 laser. Typical experimental conditions and results are described for the irradiation of diethyl ether at long trapping times and low pressures. The processes occurring during the photoionization were determined. The dissociation rate has a linear relationship with irradiation time and no dependence on wavelength over the 925 to 1090 cm^{-1} tuning region of the laser. (JSR)

RADIATION CHEMISTRY

57289 Solvent participation in reactions. II. Reactions of the cystamine anion radical. Micic, O.I. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Nenadovic, M.T.; Carapellucci, P.A. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **100**: No. 7, 2209-2212(29 Mar 1978).

First-order decomposition of the anion radical $RSSR^-$ ($RSSR^- \rightarrow RS. + RS^-$) formed in cystamine solutions was studied by pulse radiolysis. The rate constants and activation energies of this reaction were determined in sucrose, glycerol, and ethanol aqueous solutions. Solvent cage effects seem to be important in more viscous media and determine the rate of separation of products. The reaction rate of electron transfer from the $RSSR^-$ radical to oxygen ($RSSR^- + O_2 \rightarrow RSSR + O_2^-$) was also determined in the same solutions. This reaction is affected by dielectric properties of solutions and enhanced in polar media.

57290 Kinetics of free-radical decay in irradiated polyethylene terephthalate fibers. Stannett, V. (North Carolina State Univ., Raleigh); Memetea, T.; Dole, M.; Salik, J. *J. Polym. Sci., Polym. Lett. Ed.;* **16**: No. 2, 63-65(Feb 1978).

Free radicals produced in the γ-irradiation of PET fibers, decay at two different rates, a fast decay in the amorphous regions and a slower decay in the crystalline regions. The Q-function method was used to determine the mole fractions and second-order rate constants for the doses of 15 and 7.5 Mrad. The rate constants are greater for the 15-Mrad dose. (DLC)

57291 Electron solvation in polar liquids. Kevan, L.; Fueki, K. (Nagoya Univ., Japan). *Chem. Phys. Lett.;* **49**: No. 1, 101-102(1 Jul 1977).

Experimental and theoretical evidence for the dominance of first solvation shell orientation on the spectral changes observed during electron solvation is evaluated.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

57292 Experiments on chemical concentration of a new spontaneously fissile nuclide from material of the Allende meteorite. Zvara, I.; Flerov, G.N.; Zhuikov, B.L.; Reetz, T.; Shalaevskii, M.R.; Skobelev, N.K. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 240-243(Sep 1977).

On the assumption that the new nuclide belongs to the superheavy elements, the meteorite material was heated in a flux of hydrogen and oxygen to 1000°C and the sublimed products were collected. Under these conditions we extracted the chemical homologs of elements 112—118 and other known volatile elements. The spontaneously fissile activity of the sublimate, measured by means of proportional counters, amounted to about 0.02 decay/day per kg of meteorite material. This is close to the data of Flerov et al. obtained in measurement of the activity of the new emitter in the initial material of the Allende meteorite by means of multiple neutron emission counters.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 56615, 56639

57293 (BNL—24570) **Direct measurement of the fraction of radon loss in ceramics by gamma-ray spectroscopy.** Carriveau, G.W.; Harbottle, G. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract EY-76-C-02-0016. 5p. (CONF-780366—1). Dep. NTIS, PC A02/MF A01.

From 18. symposium on archaeometry and archaeological prospection; Bonn, F.R. Germany (14 Mar 1978).

Work is reported which deals with an alternative method of measuring the amount of radon loss in ceramics and clays and results from several types of sherds are presented. The gamma rays emitted by all the radioisotopes naturally present in sherds were measured, the gamma emission rates from radioisotopes preceding and following the radon in the natural series were calculated, and these rates in cases where the escape of radon was (a) prevented and (b) favored were compared. Results indicate that there was no radon loss within the accuracy limits of the experiment for any of the samples during a pumping period of up to 24 days. This rules out the possibility of appreciable radon diffusion with a diffusion mean life less than an order of magnitude greater than the half life of ^{222}Rn for these sherds. In addition, two samples of powder were specifically included to see if crushed sherds or unfired clay would influence radon loss. There was no observable radon loss with these samples.

57294 (ORO—4447-074) **Chemical properties of einsteinium. Part II.** Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26;EY-76-S-05-4447. 30p. (CONF-780134—3). Dep. NTIS, PC A03/MF A01.

From Symposium commemorating the 25th anniversary of the discovery of elements 99 and 100; Berkeley, CA, USA (23 Jan 1978).

The history and some of the equipment used to study the chemistry of Es are reviewed. The absorption spectra of Es^{3+} and the diffraction characterization of Es compounds are discussed. Evidence suggests that Es is a divalent metal whose mp is 860 +- 30°C. Characterization of Es compounds is now chiefly by absorption spectrophotometry. The spectra of Es^{3+} and Es^{2+} in $LaCl_3$ are compared. It is concluded that the chemistry of Es has been characterized in three oxidation states O (metallic state), + 2, and +3, with O being the least studied. (17 figures, 2 tables, 13 references). (DLC)

RADIOISOTOPE PRODUCTION

57295 (TREE—1116, pp 149-151) **Ion exchange separation of tracer amounts of ^{244}Cm from milligram amounts of ^{241}Am.** Turk, E.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Dowex 50 x 8 resin was used in the development of the ion exchange separation of Cm from Am. Columns with the following dimensions were constructed using 200-400 mesh resin: 2 mm I.D. x 17 cm, 2 mm I.D. x 30 cm, 6 mm I.D. x 53 cm. These columns were run at tracer levels of both ^{244}Cm and ^{241}Am, and at tracer level ^{244}Cm with macro amount ^{241}Am (approximately 1 mg). The eluant used was 0.4 M alpha hydroxy isobutyric acid with pH adjusted by conc. NH_4OH addition to pH 3.80 (17 cm and 30 cm column runs) and pH 4.02 (53 cm column run). In both the 17 cm and 30 cm column run tracer level separation of ^{241}Am and ^{244}Cm was attained but with macro amount of ^{241}Am the separation was poor. This led to construction and testing of the 53-cm-long column which worked very well at both tracer and macro ^{241}Am levels.

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 56464, 57500

57296 (AD-A—049382) **Mathematical theory of laminar combustion. I. Governing equations. Technical summary report.** Buckmaster, J.D.; Ludford, G.S.S. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Nov 1977. Contract DAAG29-75-C-0024. 28p. (MRC-TSR—1803). NTIS PC A03/MF A01.

The governing equations of combustion are derived from the standpoint of continuum mechanics; and, an indication is given of how their rational analysis can be based on activation-energy asymptotics. (Author)

57297 (AD-A—049497) **Quenching of two-dimensional premixed flames. Technical summary report.** Buckmaster, J. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Dec 1977. Contract DAAG29-75-C-0024. 53p. (MRC-TSR—1814). NTIS PC A04/MF A01.

An analysis is undertaken, both mathematical and numerical, of the quenching of two-dimensional premixed flames under a variety of circumstances. The discussion is divided into two parts, the first of which deals with quenching due to proximity to a surface through which there are heat losses, the second, quenching due to a shear flow of the kind experienced by a flame attached to a wire. The discussion includes a critical appraisal of flame stretch and the role sometimes claimed for it in intuitive explanations of flame quenching.

57298 Estimating the normal propagation velocities of laminar and small-scale turbulent flames. Baushev, V.S.; Vilyunov, V.N. *Zh. Prikl. Mekh. Tekh. Fiz.;* No. 3, 28-37(1976). (In Russian).

With the most general assumptions (taking into account the effect of Lewis-Semenov number, thermal expansion, variation in thermal parameters, etc.), analytical estimates are obtained for the normal burning velocities of laminar and turbulent flames. With an Archenius dependence of reaction rate as a function of temperature, the burning rate is represented by an asymptotic series with respect to a Frank-Kamenetskii, dimensionless temperature; for a turbulent flame the burning rate is represented with respect to a parameter of the relative scale of turbulence. Final results over a wide range of parameter changes are compared with a numerical calculation of the exact equations on a computer, and with relationships obtained according to the method of combination, asymptotic decompositions.

ENGINEERING

FACILITIES AND EQUIPMENT

57299 (GA-A—14817) **Fretting wear of heat exchanger tubes.** Blevins, R.D. (General Atomic Co., San Diego, CA (USA)). Apr 1978. Contract EY-76-C-03-0167-065. 46p. (CONF-780922—1). Dep. NTIS, PC A03/MF A01.

From ASME conference on power generation; Dallas, TX, USA (10 Sep 1978).

The results of a series of measurements made on the fretting wear of heat exchanger tubes and support plates at room temperature in a nitrogen/air atmosphere are presented. The fretting wear is shown to be a function of the amplitude and frequency of tube vibration as well as the gap between the tube and the support plate and the mean load supported by the tube. Conceptual and empirical models are developed for the fretting wear of heat exchanger tubes. The models are based on the experimental data on the concept that fretting wear is the result of relative motion between the tube and the support plate.

57300 (SAND—77-1291) **Preliminary report on development of an interim parachute recovery system (IRS) for a reentry vehicle.** Pepper, W.B. Jr. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 30p. Dep. NTIS, PC A03/MF A01.

Results of tests conducted on a two-stage parachute system consisting of a 19-in.-dia ribbon parachute made of Kevlar-29 and a 3-ft-dia guide surface, second-stage parachute with a nylon canopy and Kevlar-29 suspension lines are reported. A 1.75 ft^3 ram, air-filled flotation bag is used for ocean recovery of the 57-lb nose cone. Recovery was started by jettisoning 63 percent of the initial reentry mass prior to deploying the parachute.

57301 (SAND—78-0311) **Comparison of calculations with high velocity soil penetration data.** Yarrington, P. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

Calculations of deceleration and final depth made with the computer program PENAP are compared with data from a series of full-scale penetration tests conducted at the Tonopah Test Range, Nevada. A relatively simple, five layer, two material model was used in the calculations to represent the layering of soils at the test site. The agreement between observed and calculated results is felt to justify a reasonable amount of confidence in the PENAP code as an approximate method for earth penetration analysis.

57302 (SAND—78-1310C) **Simulation of tamped impulse with an electrically explosed etched copper mesh.** Forrestal, M.J.; Butler, R.I.; Sagartz, M.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-780679—1). Dep. NTIS, PC A02/MF A01.

From JOPWOG-6/SubWOG-268 meeting; Albuquerque, NM, USA (27 Jun 1978).

An impulse simulation technique for radiation-induced material blowoff on layers internal to reentry body shell structures was explored. Etched copper mesh patterns were exploded with current from a capacitor discharge. Impulse intensities between 1000 and 10,000 taps were produced on a simulated shell structure which was separated from the mesh by a 1.25 mm (0.05 in.) air gap.

57303 Rigorous and short-cut design calculations for gas absorption involving large heat effects. I. A new computational method for packed gas absorbers. Von Stockar, U.; Wilke, C.R. (Univ. of California, Berkeley). *Ind. Eng. Chem., Fundam.;* **16**: No. 1, 88-93(Feb 1977).

Gas absorption in packed columns has been modelled taking into account all heat effects for physical gas absorption. Multicomponent diffusion effects were incorporated in terms of the film factor concept. An algorithm of very stable convergence behavior was obtained by simulating the start-up procedure of the column dynamically in order to evaluate the steady-state operation. The importance of rigorous design calculations was assessed by comparing the rigorous solution with simplified hand calculations for a large number of cases. If the solvent is volatile, it appears impossible to estimate the highly irregular temperature profiles by hand and to design the column approximately by simplified calculations based on neglecting one or more of the heat effects. Simplifying assumptions are also unsuitable to obtain a limiting conservative design.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 56919, 57482, 58066

57304 Superconducting antenna. Pavlyuk, V.A.; Krivosheev, E.F.; Mikhailov, V.I.; Tarasov, A.V. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 80(Feb 1978).

The gain of an antenna using superconducting wire is measured as a function of the elongation coefficient. Loop and whip antennas are considered.

57305 Fluctuations in a SQUID with rf bias. Chetaev, M.N.; Shnyrkov, V.I. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 86-88(Jan 1978).

Experiments on a toroidal interferometer with a quantized loop inductance of 3 x 10^{-11} H show that it is possible to achieve a sensitivity of 7.5 x 10^{-6} Phi$_0$/Hz/sup 1/2/ (Phi$_0$ is the quantum of magnetic flux) in hysteresis operation with a bias frequency of 30x10^6 Hz. The sensitivity of this interferometer in nonhysteresis operation, with the same bias source is of the order of 10^{-3} Phi$_0$/Hz/sup 1/2/. When the fluctuation characteristics of the rf bias sources are taken into account it is concluded that it is preferable to operate the interferometer in the hysteresis mode. It is concluded from theory and experiment that nonhysteresis operation is advisable only if improved bias sources can be used.

57306 Effect of residual gas on a superconducting cavity. Korovin, O.P. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of USSR, Leningrad). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 11, 1421(Nov 1977).

It is shown that thermomagnetic breakdown in a superconducting cavity is caused by the formation of droplets of residual gas. (AIP).

PROTECTIVE STRUCTURES AND EQUIPMENT

57307 (DPSPU—78-30-12) **Improved airline-type supplied-air plastic suit.** Jolley, L. Jr.; Zippler, D.B.; Cofer, C.H.; Harper, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1978. Contract EY-76-C-09-0001. 15p. (CONF-780657—3). Dep. NTIS, PC A02/MF A01.

From 23. meeting of the Health Physics Society; Minneapolis, MN, USA (18 Jun 1978).

Two piece supplied-air plastic suits are used extensively at the Savannah River Plant for personnel protection against inhalation of airborne plutonium and tritium. Worker comfort and noise level problems gave impetus to development of an improved suit and aid distribution system. The resulting plastic suit and development work are discussed. The plastic suit unit cost is less than $20, the hearing zone noise level is less than 75 dBA, protection factors exceed 10,000, and user comfort is approved. This suit is expected to meet performance requirements for unrestricted use.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 56622, 56623, 56651

57308 (TREE—1116, pp 222) **Upgrade of nuclear criticality safety evluation techniques.** Lofthouse, J.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

An effort has been made over the past year to upgrade the tools and techniques for performing nuclear criticality evaluations at INEL. An upgraded version of the Monte Carlo neutronics code, KENO IV, was obtained from the developers at ORNL and made operational on the INEL IBM-360 computer system. When it became known that the new INEL computer system would be a CDC CYBER 70/model 76, a version of KENO IV compatible with this system, was requested from ORNL. The actual code conversion

was made by CDC and was made operational on their machine at Minneapolis. A copy of the magnetic tape containing this program has been received at INEL and is in the process of being made operational on the CYBER 70 system. The next step is to bring both the IBM 360 and the CYBER 70 versions of the code, along with the cross-section libraries used for criticality calculations, under configuration control so that a calculation is completely traceable. In addition, the upgraded Hansen-Roach cross-section library received on the same tape with KENO IV has been put into a format compatible with the one-dimensional S/sub n/ transport code, SCAMP, and the one-dimensional diffusion code, MONA. In addition to the conversion, appropriate transport cross sections were generated and included in the library so that non-infinite systems can be handled using SCAMP or MONA. These tools now provide a consistent base for performing nuclear criticality calculations.

57309 (TREE—1116, pp 228) **Criticality evaluation of PBF 5-ton cask.** Lofthouse, J.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Calculations were performed to determine a safe loading limit for the PBF 5-ton cask. The limit was set at 10 kg ^{235}U. (LK)

SHIPPING CONTAINERS

57310 (SAND—77-1486) **Evaluation of organic coolants for the transportation of LMFBR spent fuel rods.** Arnold, C. Jr. (Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-6-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

The physical and chemical processes that are likely to occur when sodium coated LMFBR spent fuel rods are submerged in various aromatic organic coolants was defined by means of immersion experiments carried out with sodium coated 304 stainless steel coupons. Upon immersion of sodium coated coupons at 220°C in hydrocarbon type coolants such as Therminol 88, a mixture of terphenyls, not only was the metallic sodium retained on the coupon, but a carbonaceous coating formed on the surface of the sodium. In contrast, coolants that contained aromatic ether bonds, such as Dowtherm A, reacted with sodium at 220°C to form phenolate and other salts, which precipitated from the coolant in the form of a dark sludge. With Dowtherm A, removal of metallic sodium from the coupon was essentially complete in a matter of hours at temperatures of 160—220°C. Data on the rate and efficiency of sodium removal upon immersion in Dowtherm A at elevated temperatures were obtained. In addition the kinetics and chemistry of the sodium/Dowtherm A reaction were defined. Because sodium sludges are potentially incompatible with the containing structural materials and the fuel elements, it is recommended that sodium be removed prior to immersion in the coolant via reaction with benzoic acid; this method should be adaptable to the facilities at reactor sites. In aging studies Dowtherm A was found to be thermally stable up to 400°C and radiatively stable at ambient conditions. The combined effect of heat and radiation was not defined.

57311 (SAND—77-2053) **Management plan for the procurement of shipping casks required to service proposed federal waste repositories.** Renken, J.H.; Dupree, S.A.; Allen, G.C. Jr.; Freedman, J.M. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 104p. Dep. NTIS, PC A06/MF A01.

Development of transportation systems to move radioactive waste and unreprocessed spent fuel to proposed federal waste repositories is an integral part of the National Waste Terminal Storage Program. To meet this requirement, shipping casks must be designed, licensed, and fabricated. To assist the manager charged with this responsibility, a Cask Procurement Plan has been formulated. This plan is presented as a logic diagram that is suitable for computer analysis. In addition to the diagram, narrative material that describes various activities in the plan is also included. A preliminary computer analysis of the logic diagram indicates that, depending on the result of several decisions which must be made during the course of the work, the latest start dates which will allow prototype delivery of all types of casks by December 1985, range from November 1977 to March 1982.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 57467

57312 Seafloor cone penetrometer for deep penetration measurements of ocean sediment strength. Ferguson, G.H.; McClelland, B.; Bell, W.D. pp 471-478 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Foundation design and construction planning for offshore structures are rapidly becoming more complex, involving a wide variety of foundation types, foundation elements, installation procedures and subsurface conditions. Maximum water depths and foundation loads are increasing, and severe environmental conditions producing multiple-hazards are more common. Sophisticated analyses developed for these conditions require accurate and thorough soil property evaluation. In situ testing of soil properties, such as Remote Vane and cone penetrometer tests, enhance the information obtained from laboratory tests on soil samples. A remotely-controlled, hydraulically-operated, seafloor-based system called Stingray has been developed by McClelland engineers which operates in conjunction with offshore drilling equipment to provide continuous cone penetrometer information, high-quality soil samples and other in situ measurements to any drillable penetration from a floating base. This powerful capability of testing below formations which normally cause cone penetrometer refusal assures information for deep as well as shallow foundation designs. Results are presented from the onshore development and testing of the Stingray system, and from the offshore use of the cone penetrometer, mechanical and readout subsystems.

LASERS

REFER ALSO TO CITATION(S) 57240

57313 (AD—907100) **Space laser design. Final technical report.** Mongeon, R.J.; Flynn, J.T. (United Aircraft Corp., East Hartford, CT (USA)). Nov 1972. Contract F33615-72-C-1957. 78p. NTIS PC A05/MF A01.

Conductive cooling of a Nd:YAG laser crystal is realized by cradling the silvercoated rod in a copper heat sink. Pump radiation illuminates the rod from the side through a window in the solid housing; and as a result, the entering pump radiation is efficiently trapped in the weakly absorbing laser crystal. Two cavities, both employing 'cold' mirrors to filter the pump radiation, were designed to pump the narrow side aperture. A non-imaging design, employing flat dielectric mirrors, proved less efficient than a hybrid imaging design which employed a combination of elliptical and circular cylindrical dielectric mirrors to efficiently pump the conductively cooled laser. The latter cavity delivered 1.5 W of multimode laser power when pumped with 300 W from a K-Rb lamp. (Author)

57314 (AD—911741) **Airborne continuous wave carbon dioxide laser for reconnaissance applications. Final report, 10 March 1971—28 February 1973.** Gustafson, H.A.; Mocker, H.W. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Apr 1973. Contract F33615-71-C-1421. 64p. NTIS PC A04/MF A01.

The design, construction and tests of a stable 100 watt airborne CO_2 laser for reconnaissance application is described. Design emphasis was placed on a high laser frequency and amplitude stability and long-term emission in a P(20) line at 10.591 micrometers only. Conventional CO_2 lasers generally emit at several lines in the rotation vibration band around 10.6 and 9.6 microns and are thus not feasible for homodyne or heterodyne application. Further design emphasis was placed on beam quality and compact rugged construction. The emitted beam is in the zero order transverse mode (TEM sub 00) with a diffraction limited beam spread of 2.5 mrad. Additional collimation by means of an off-axis cassegrain optical system reduces the beam spread to less than 1 mrad. The beam directional stability over a temperature range of 30F was found to be better than 0.2 mrad. The amplitude stability of the laser is better than 5% over the frequency range of 0.05 Hz to 10 MHz. This high degree of stabilization was obtained by constructing the laser cavity from ultra-low expansion quartz (ULE quartz) which provides a high passive stability without the need for active electronic stabilization. A folding technique for the plasma tubes was used to reduce the overall length of the laser to 57 inches. One cavity mirror is provided with piezoelectric length selection and a second cavity mirror is equipped with an angular alignment capability. Extensive performance tests were made which indicated that the laser meets and exceeds all of the above listed design specifications.

57315 (AD-A—049551) **Small scale discharge studies. Semi-annual report, 1 March—31 August 1977.** Mangano, J.A.; Rokni, M.; Jacob, J.H.; Hsia, J.C. (Avco-Everett Research Lab., Everett, MA (USA)). 31 Aug 1977. Contract N00014-75-C-0062. 80p. NTIS PC A05/MF A01.

Rare gas fluoride lasers are discussed in detail. There is a significant interest in these lasers because they are the most efficient visible/UV lasers to date. The dominant formation kinetics of KrF^* and XeF^* in both discharges and e-beam pumped lasers are presented. Because of the ionic upper level the formation processes are rapid and conditions can be chosen such that the branching ratio into the KrF^* and XeF^* levels from both the ionic and metastable levels are unity. In e-beam pumping, a guide magnetic field enables the deposition of 70% of the beam energy into the optical volume. If

two e-beams can be used > 90% of the fast electron energy can be deposited into the optical volume. Discharge pumping has the potential of being more efficient than e-beam however, key technical issues of discharge stability, and metastable production efficiency have to be addressed. Stabilization of the discharge appears possible if an external source of ionization is used. The quenching of the rare gas fluorides by two or three body processes have been carefully measured and analyzed. The three body quenching of KrF^* leads to the eventual formation of the excited triatomic Kr_2F^* which radiates in a broad-band centered at 410 mm. It was also determined that ionic and excited state absorption in the active media are large enough to impact the extraction efficiency of these lasers.

57316 (AD-A—049583) **Optical conversion processes. Final report, 15 September 1976—15 November 1977.** Trainor, D.W.; Mani, S.A. (Avco-Everett Research Lab., Everett, MA (USA)). Jan 1978. Contract N00014-76-C-1162,. 51p. NTIS PC A04/MF A01.

The overall goal of this experimental program is to identify scalable techniques that efficiently convert existing high power UV lasers to lasers operating at longer wavelengths in the visible. Two nonlinear optical conversion techniques that we have considered are: stimulated Raman and parametric conversion involving the KrF laser (248 nm). The objective of this contract is to suggest likely acceptor atoms for each technique which will thereby allow us to evaluate some of the key technical issues involved. These include: the production of acceptor candidates in the gas phase (typically refractory metals), the volumetric removal of the lower laser level in the stimulated Raman approach to prevent 'bottle necking' and allow recycling of the atoms during the laser pulse, and the consideration of overall system efficiency and scalability to high power.

57317 (AD-A—049623) **Feasibility study of rare earth semiconductor lasers of the type Y_2HfS_5. Technical report.** Morrison, C.A.; Karayianis, N.; Wortman, D.E. (Harry Diamond Labs., Washington, DC (USA)). Dec 1977. 19p. (HDL-TR—1836). NTIS PC A02/MF A01.

The possibility of making a rare earth or rare earth doped semiconductor laser was investigated. The material examined in detail was Y_2HfS_5, which is of the general class of materials Ln_2TX_5, where Ln is a rare earth, T is zirconuim or hafnium, and X is sulfur or selenium. For Y_2HfS_5;Nd, the Stark split energy levels of Nd(3+) were determined in the energy range 0 to 2 eV (the band gap of Y_2HfS_5). The individual line to line transition probabilities were calculated assuming S4 symmetry for the Nd (3+) site, and the branching ratios are given. The calculated branching ratio for spontaneous emission of the 4F (3/2) to the 4I (1/2) is 0.574, and the next largest branching ratio of the 4F (3/2) to 4I (9/2) is 0.298. The branching ratio for the 4I (1/2) is larger in this material than the calculated branching ratio for Nd in YAG, which is 0.480. The transition probabilities are used to calculate the excitation of the various multiplets by conduction electrons.

57318 (AD-A—049858) **Generation of coherent vuv and soft x-rays. Semiannual report No. 5, 1 July—31 December 1977.** Harris, S.E.; Young, J.F. (Stanford Univ., CA (USA). Center for Materials Research). Jan 1978. Contract N00014-75-C-1175,. 24p. (CMR—78-2; GL—2770). NTIS PC A02/MF A01.

The goal of this program is the development of practical sources of coherent vacuum ultraviolet radiation. During this reporting period the primary effort has been on the development of a new type of VUV light source based on spontaneous anti-Stokes scattering. This type of source may prove bright enough to serve as a pump for very short wavelength lasers. Details of the work are included. In addition, on investigation of factors limiting the efficiency of 3547 A to 1182 A generation in Xe was completed; a manuscript describing the results has been accepted for publication the IEEE Journal of Quantum Electronics.

57319 (AD-A—051063) **Chemical lasers and laser-induced kinetic processes. Final report, 1 October 1974—30 September 1977.** Pimentel, G.C. (California Univ., Berkeley (USA). Dept. of Chemistry). 30 Sep 1977. 22p. NTIS PC A02/MF A01.

The 'Tandem Laser' and 'Zero Gain' methods (developed in these laboratories) to study the primative vibrational populations obtained in selected chemical reactions have been exploited. The NH-fluoromethane insertion-elimination reactions were carefully examined as a prototype example of this type of chemical laser.

57320 (AD-A—051534) **One meter KrF laser system. Semiannual report, 23 February—22 August 1977.** Hsia, J.C.; Jacob, J.H.; Mangano, J.A.; Rokni, M. (Avco-Everett Research Lab., Everett, MA (USA)). 22 Aug 1977. Contract N00014-76-C-1032. 104p. NTIS PC A06/MF A01.

This interim report covers research directed towards efficient high power UV/visible lasers. The key issues being addressed are: (1) e-beam and e-beam controlled discharge excitation, (2) laser kinetics and modeling, (3) discharge stability and enhancement, (4) laser medium gain, adsorption and energy extraction and (5) intrinsic laser efficiency and scaling. Using e-beam controlled discharge pumping of a one meter KrF laser, 75 joules of laser output was obtained with 10% intrinsic efficiency at a specific energy of 10 J/liter. The use of an externally applied magnetic field to guide the e-beam is shown to effectively prevent e-beam steering by the discharge current and thus allow this excitation technique to be scaled to large laser apertures and very large single pulse energies. For efficient discharge pumping spatial e-beam energy deposition uniformity is shown to be important and methods of improving the deposition uniformity are proposed. Using pure e-beam excitation of XeF, a laser output of 36 joules was obtained with 2.6% intrinsic efficiency at a specific energy of 8 J/liter. Processes limiting XeF laser efficiency are identified and remedies proposed.

57321 (TRITA-EPP—77-26) **Current limitation by an electric double layer in ion laser discharges.** Torven, S. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Dec 1977. 7p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A theory for current limitation in ion laser discharges is investigated. The basic mechanism considered is saturation of the positive ion flux at an electric double layer by the limited flux of neutral atoms. The result is compared with a recently published synthesis of a large number of experimental data which agree well with those predicted by the double layer model.

57322 (UCRL—13869) **Copper ion laser development. Final report.** (Colorado State Univ., Fort Collins (USA)). 1 Jun 1978. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The design, operation, and performance of a copper ion laser developed by Colorado State University personnel are described. The laser consists of a neon discharge excited in a copper hollow cathode. The metal density necessary for laser action was obtained by discharge spattering of the copper cathode rather than by external ovens. The laser output is at the CuII 2485 A transition.

57323 **Transfer and quenching rate constants for XeF(III,1/2) and XeF(II,3/2).** Brashears, H.C. Jr.; Setser, D.W. (Chemistry Department, Kansas State University, Manhattan, Kansas 66506). *Appl. Phys. Lett.;* **33**: No. 9, 821-823(1 Nov 1978).

Rate constants for transfer between XeF(III,1/2) and XeF(II,3/2) states and quenching of XeF(III,1/2) have been measured using a method which employs the steady-state photolysis of XeF_2. For He, Ne, Ar, Kr, N_2, CF_4, and SF_6 transfer dominates over quenching; for Xe, NF_3, CF_3Cl, and CF_3H quenching and transfer are competitive. Only for F_2 is quenching dominant. Based upon the relative emission intensities from XeF(III,1/2) and XeF(II,3/2) at high pressures of buffer gases, XeF(II,3/2) must be 0.08 eV lower in energy than XeF(III,1/2).

57324 **New saturable absorber for the CO_2 laser using doped KCl.** Ahrenkiel, R.K.; Figueira, J.F.; Phipps, C.R. Jr.; Dunlavy, D.J.; Thomas, S.J.; Sievers, A.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Appl. Phys. Lett.;* **33**: No. 8, 705-707(15 Oct 1978).

A new class of saturable absorbers for 10-μm applications using doped alkali halides is demonstrated. For the ReO^-_4 molecular ion in KCl, the vibrational transition saturates like an ideal two-level system. This behavior is a result of the large anharmonic shift in the absorption spectra of the dopant ion. Saturation parameters of 1.45 MW/cm^2 and a relaxation time T_1 of 120 ps are measured at room temperature.

57325 **Experimental evidence for soft x-ray population inversion by resonant photoexcitation in multicomponent laser plasmas.** Bhagavatula, V.A. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14627). *Appl. Phys. Lett.;* **33**: No. 8, 726-728(15 Oct 1978).

High-intensity laser-plasma experiments conducted on targets consisting of carbon and magnesium indicate population inversion in Mg^{+10} and Mg^{+11} ions at wavelengths of ~100 A. The results indicate that soft x-ray population inversion has been achieved, for the first time, by resonant photoexcitation. By this process, intensity inversions of the hydrogenic resonance lines from n=3 and n=4 are observed at electron densities as high as $10^{20}\,cm^{-3}$.

57326 **Efficient, high-power F_2 laser near 157 nm.** Woodworth, J.R.; Rice, J.K. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Chem. Phys.;* **69**: No. 6, 2500-2504(15 Sep 1978).

We have demonstrated high powers (7 MW) and high efficieny (3.5%) in an e-beam excited, molecular F_2 laser operating in mixtures of high pressure He and a few Torr of F_2. The wavelengths of the three F_2 laser lines observed are 156.71, 157.48, and 157.59 nm.

57327 **Efficient operation of the electron-beam-pumped XeCl laser.** Champagne, L.F. (Naval Research Laboratory, Washington, D.C. 20375). *Appl. Phys. Lett.;* **33**: No. 6, 523-525(15 Sep 1978).

Efficient operation (5.0%) of the long-pulse (0.5 μsec) XeCl laser is obtained by electron-beam pumping of mixtures of neon,

xenon, and HCl. Laser emission is observed at 308.0 and 308.2 nm. A small-signal gain of 2.6% cm^{-1} is measured from which the saturation intensity is calculated to be ~0.35 MW cm^{-2} and the optical absorption at the laser wavelength is calculated to be ~0.26% cm^{-1}. The electron-beam-pumped XeCl laser can be operated under static fill conditions with no measurable degradation in output power.

57328 High-efficiency pulsed 10.6-μm phase-conjugate reflection via degenerate four-wave mixing. Bergmann, E.E.; Bigio, I.J.; Feldman, B.J.; Fisher, R.A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Opt. Lett.;* **3**: No. 3, 82-84(Sep 1978).

We present the first reported observation in the infrared of nonlinear phase-conjugated reflection. This was achieved via degenerate four-wave mixing in polycrystalline germanium. The observation was facilitated by taking advantage of the counterpropagating (strong) waves internal to a pulsed CO_2 laser cavity. The measured effective reflectivity was 2% with a 10-mm interaction length. This simple intracavity technique is generally applicable to any nonlinear material transparent at the wavelength of the laser into which it is inserted.

57329 Laser induced damage in optical materials: ninth ASTM symposium. Glass, A.J.; Guenther, A.H. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Appl. Opt.;* **17**: No. 15, 2386-2411(1 Aug 1978).

The Ninth Annual Symposium on Optical Materials for High Power Lasers (Boulder Damage Symposium) was held at the National Bureau of Standards in Boulder, Colorado, 4—6 October 1977. The symposium was under the auspices of ASTM Committee F-1, Subcommittee on Laser Standards, with the joint sponsorship of NBS, the Defense Advanced Research Project Agency, the Department of Energy (formerly ERDA), and the Office of Naval Research. About 185 scientists attended, including representatives of the United Kingdom, France, Canada, Australia, Union of South Africa, and the Soviet Union. The Symposium was divided into sessions concerning Laser Windows and Materials, Mirrors and Surfaces, Thin Films, Laser Glass and Glass Lasers, and Fundamental Mechanisms. As in previous years, the emphasis of the papers was directed toward new frontiers and new developments. Particular emphasis was given to materials for use from 10.6 μm to the uv region. Highlights included surface characterization, thin film-substrate boundaries, and advances in fundamental laser—matter threshold interactions and mechanisms. The scaling of damage thresholds with pulse duration, focal area, and wavelength were also discussed. Alexander J. Glass of Lawrence Livermore Laboratory and Arthur H. Guenther of the Air Force Weapons Laboratory were cochairpersons. The Tenth Annual Symposium is scheduled for 12—14 September 1978 at the National Bureau of Standards, Boulder, Colorado.

57330 Apparatus for producing an electric glow discharge in a flowing gas. Foster, J.D. (to Universal Laser Corp.). US Patent 4,096,449. 20 Jun 1978. Filed date 14 Jan 1977. 6p.

An apparatus is described for producing an electric glow discharge in gas flowing along a channel with the discharge extending in a direction generally transverse to the flow. The apparatus includes a first electrode adjacent to a first wall of the flow channel and a generally planar second electrode adjacent to a second wall of the flow channel opposed to the first wall. The second electrode is formed of a material having a resistivity in the range of 10^2 to 10^6 ohm-centimeters. Means for electrically energizing the first and second electrodes to establish the glow discharge are also provided.

57331 High-power multibeam cw CO_2 laser. Kozlov, G.I.; Kuznetsov, V.A.; Masyukov, V.A. (Institute of Problems of Mechanics, Academy of Sciences of the USSR). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 53-54(Feb 1978).

Details are given of the design of a high-power CO_2 laser in which the radiation is produced in a set of parallel beams. The maximum power of each beam is 100 W.

57332 Ar:Xe:CCl_4 discharge laser. Fedorov, A.I.; Tarasenko, V.F.; Bychkov, Y.I. (Institute of High-Current Electronics, Siberian Branch, Academy of Sciences of the USSR). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 54-55(Feb 1978).

It is demonstrated that Ar can be used as a buffer gas in an excimer discharge laser. Output energy is given as functions of pressure and composition.

57333 Stabilization of giant pulses from a neodymium laser. Nilov, E.V.; Rusov, V.A. *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 56-58(Feb 1978).

A photoelectric feedback system is described which stabilizes the amplitude fluctuations of the output of a Nd laser.

57334 Tuning and stabilization of an optically pumped carbon tetrafluoride laser. Alimpiev, S.S.; Baronov, G.S.; Karlov, N.V.; Karchevskii, A.I.; Martsynk'yan, V.L.; Nabiev, S.S.; Khokhlov, E.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 69-70(Feb 1978).

A pulsed CO_2 laser emitting 9-μ radiation, was used to optically pump a CF_4 laser. Details of the optical system that permitted stabilization and tuning in the range 612—647 cm^{-1} are discussed.

57335 Photodissociation laser with bis(trifluoromethyl)phosphine iodide. Dymov, B.P.; Skorobogatov, G.A. (A. A. Zhdanov Leningrad State University). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 73-75(Jan 1978).

A comparative study is made of the characteristics of the stimulated emission of photodissociation iodide lasers with the iodides CF_3I, C_3F_7I, and $(CF_3)_2PI$ as working media. Possible mechanisms for the cutoff of lasing in these systems are examined. It is concluded that gasdynamic effects make an important contribution to the quenching.

57336 Mode selection in high-power argon lasers. Alferov, G.N.; Grigor'ev, V.A.; Donin, V.I. (Institute of Semiconductor Physics, Siberian Branch of the Academy of Sciences of the USSR, Novosibirsk). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 12-15(Jan 1978).

An analysis is made of the feasibility of using various types of resonators for mode selection in a high-power cw argon laser with large-aperture discharge tube. Three resonator configurations were investigated experimentally. Single-frequency radiation with a power of 20 W at λ=514.5 nm and a coefficient of conversion to the single-frequency regime of eta≅0.4 was obtained from an argon laser with a discharge tube of diameter d=14 mm and active length l/sub O/≅1.7 m. Some aspects of further improvement of the output parameters of a high-power argon laser with mode selection are discussed.

57337 Modes of a system of two coupled ring resonators. Arendt, V.G.; Godenko, L.P.; Danileiko, M.V.; Mashkevich, V.S. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 31-33(Jan 1978).

An electrodynamic method is used to calculate the frequencies and amplitudes of modes in a system of two coupled ring resonators. It is shown that the spectrum of such a system is nonequidistant and the mode fields are concentrated, depending on the frequency, in one or the other resonator. The case of equal perimeters of the two resonators is considered in detail.

57338 New passive Q switch for Nd^{3+} lasers. Bezrodnyi, V.I.; Ponezha, E.A.; Tikhonov, E.A. (Institute of Physics, Academy of Sciences of the Ukranian SSR, Kiev). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 34-37(Jan 1978).

Results are presented of an investigation of passive Q switches for Nd^{3+} lasers based on a new group of alcohol-soluble tricarbocyanine dyes. The advantages of the new switches over the familiar dye No. 3955 solution in terms of photochemical stability, energy efficiency, and relaxation time are indicated. It is shown that switches based on alcohol solutions of these dyes give a high degree of spatial homogeneity of the beam energy over the total cross section of the active zone. The duration of picosecond pulses emitted from lasers with this type of switch is 6—12 psec.

57339 Influence of backscattering on the operation of a ring laser with a methane cell. Andronova, I.A.; Mamaev, Y.A.; Markelov, N.A. (Institute of Applied Physics, Academy of Sciences of the USSR, Gorki). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 38-42(Jan 1978).

The influence of backscattering (reflection) on the position of the extremum of a "competing" methane peak in a λ=3.39μ ring laser was investigated experimentally and theoretically (a number of simplifying assumptions were made in the latter case). The experimental results indicated the possibility of a shift of this extremum by 300—500 Hz when the change due to backscattering by defects in optical elements was close to the internal phase shift.

57340 Space-time evolution of the cathode layer in electron-beam-controlled lasers. Aleksandrov, V.V.; Koterov, V.N.; Pustovalov, V.V.; Soroka, A.M.; Suchkov, A.F. (Computing Center, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 59-63(Jan 1978).

A study was made of the space-time evolution of the cathode layer in an electron-beam-controlled laser. It is shown that the formation of the cathode potential fall exhibits oscillations which are associated with space-charge fluctuations near the cathode. Estimates are made of the change in the thermodynamic state of the neutral plasma component, caused by inhomogeneous Joule heating.

57341 Efficient room-temperature stimulated emission from a Ga/sub x/In/sub 1hyphenx/As/sub y/Sb/sub 1hypheny/ semiconductor laser in the spectral range 1.8—2.4 μ. Dolginov, L.M.; Druzhinina, L.V.; Kryukova, I.V.; Lapshin, A.N.; Leskovich, V.I.; Mat-

veenko, E.V.; Mil'vidskii, M.G. (All-Union Scientific-Research Institute of Optophysical Measurements, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 66-67(Jan 1978).

The Ga/sub x/In/sub 1hyphenx/As/sub y/Sb/sub 1hypheny/ solid-solution system was found to emit stimulated radiation in the wavelength range 1.86—2.2 μ (80°K) and 2.06—2.36 μ (300°K). A study was made of the principal characteristics of electron-beam-pumped lasers utilizing these solid solutions. The maximum output power was 110 W at 80°K and 38 W at 300°K; the corresponding differential efficiencies were 5 and 3%, respectively.

57342 Influence of surface recombination on stimulated emission threshold of semiconductor lasers. Loshchenkova, E.F.; Molchanov, A.G.; Popov, Y.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 82-83(Jan 1978).

A theoretical study is made of the influence of diffusion and surface recombination on the spatial distribution of nonequilibrium carriers with depth and on the optical gain of an electron-beam-excited semiconductor laser. The dependences of the threshold current on the diffusion length, surface recombination velocity, and thickness of the "dead" layer are found for the longitudinal and transverse electron-beam pumping configurations.

57343 Pulse-periodic $Y_3Al_5O_{12}:Er^{3+}$ laser with high activator concentration. Bagdasarov, K.S.; Danilov, V.P.; Zhekov, V.I.; Murina, T.M.; Manenkov, A.A.; Timoshechkin, M.I.; Prokhorov, A.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 83-85(Jan 1978).

The development of a pulsed $Y_3Al_5O_{12}:Er^{3+}$ laser (^{4}I/sub 11/2/—^{4}I/sub 13/2/ transition, λ=2.94 μ) with activator concentrations of 30 wt.% (T=300 °K) is reported. A pulse repetition frequency of f=20 Hz was obtained under free-oscillation and Q-switched conditions. Stimulated emission due to this transition at T=300 °K was obtained over the whole concentration series of the $Y_3Al_5O_{12}$—$Er_3Al_5O_{12}$ system with Er^{3+} concentrations of between 10 and 100 wt.%.

57344 Some features of the influence of discharge-current fluctuations on the output radiation of an He—Cd^+ laser. Tuchin, V.V. (N. G. Chernyshevski State University, Saratov). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 91-93(Jan 1978).

For the first time a complete system of equations has been formulated for the populations of the energy levels of the components of an He—Cd^+ laser mixture. This system allows for the main mechanisms of establishment and saturation of the inversion and also takes account of the dynamics of transverse separation of metal vapors in cataphoretic lasers. These equations are solved for small sinusoidal discharge-current fluctuations. It is shown that in the case of an He—Cd^+ laser (unlike an He—Ne laser), the influence of the discharge-current fluctuations on the intensity has certain characteristic features. These features are associated with the involvement in the fluctuation process of the density of atoms of the active medium in the ground state and with the longer lifetime of the upper laser level.

57345 Efficiency of laser pumping by xenon flashlamps with interference coatings. Baranov, S.A.; Kolpakova, I.V.; Kononova, M.Y.; Mak, A.A.; Motovilov, O.A. *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 102-103(Jan 1978).

Results are presented of tests on xenon flashlamps with dielectric coatings deposited on their quartz bulbs. These coatings reflect ultraviolet radiation and transmit radiation in the absorption bands of neodymium glass. Depending on the type of lamp and the electrical conditions, the stimulated-emission efficiency was improved by 20—60%.

57346 Characteristics of stimulated emission from an actively Q-switched neodymium-glass laser controlled by an external signal. Zubarev, I.G.; Mikhailov, S.I. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 109-111(Jan 1978).

A study is made of the influence of an external signal on the residual free emission of a controlled laser with an inhomogeneously broadened gain line. There is no locking threshold characterized by a basic change in the operation regime at some particular intensity of the external signal: an increase in this intensity results in a smooth reduction in the power of the residual free emission. Nevertheless, the resultant distribution of the energy between narrow-band stimulated emission and noise is fully satisfactory for many practical applications.

57347 Pulsed strontium vapor laser. Platonov, A.V.; Soldatov, A.N.; Filonov, A.G. ("Optika" Special Design Bureau for Scientific Instruments, Siberian Branch of the Academy of Sciences of the USSR, Tomsk). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 120-122(Jan 1978).

An investigation was made of the power characteristics of the laser transitions in strontium atoms and ions under self-heating conditions. The total (over the whole spectrum) average output power was 1.2 W and the efficiency was 0.1% when the repetition frequency of the excitation pulses was 20 kHz in a tube 10 mm in diameter and 380 mm long. About 75% of the output power was concentrated in a line at 6.45 μ.

57348 Use of luminescent screens in determination of spectral characteristics of infrared pulsed lasers. Vasil'ev, L.A.; Morozov, Y.B.; Pykhtin, V.A.; Semenov, A.K.; Timofeev, Y.P.; Fridman, S.A. *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 122-123(Jan 1978).

A description is given of a system for the investigation of spectral characteristics of infrared pulsed lasers. The system is based on a Fabry—Perot etalon and interferograms are displayed on optically quenched luminescent screens. The mechanism of the operation of the ZnS:Cu:Co phosphor is considered and the physics of visualization of the interference pattern is explained. Technical characteristics of the luminescent screens are given. The results of the investigation and estimates of the precision of measurements of the emission line width of pulsed lasers operating in the 1.5—1.7 μ wavelength range are used to demonstrate the suitability of luminescent screens for long-wavelength interferometry.

57349 Radiative characteristics of a single-channel GaAs injection laser. Kargapol'tsev, V.S.; Malygin, E.P.; Malyshev, V.K.; Molochev, V.I.; Narzullaev, K.N.; Nikitin, V.V.; Semenov, A.S.; Talenskii, O.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 130-132(Jan 1978).

An investigation was made of the radiative characteristics of gallium arsenide laser diodes with a luminous region several microns in size. A special feature of these lasers was that they emitted a single longitudinal mode in a wide range of injection currents at 77°K. The maximum output power in this mode was ~50 mW in the cw regime. The output was highly coherent: the coherence length exceeded 10 m. A comparison was made of the energy characteristics of the lasers with active regions 6 and 200 μ wide, operating in the single-frequency regime. Single-channel lasers were found to be 10 times as effective in conversion of electrical energy into coherent radiation than wide diodes.

57350 Radiation scattering losses in a laser based on organic dye solutions. Rubinov, A.N.; Asimov, M.M. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 232-235(Aug 1976). (In Russian).

A study is made of the effect of light scattering in the active liquid on the properties of a laser based on a dye solution with lamp excitation. It is shown that in a number of cases this factor of generated light losses plays a determining role.

57351 Kinetics of relaxation in a Gaussian, noise field. Oseledchik, Yu.S. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 323-328(Aug 1976). (In Russian).

The kinetics are calculated for the population and absorption of a two-level system in a radiation field whose amplitude is modulated by a random Gaussian process. A look is taken at cases with a Rayleigh and a Gaussian distribution of rounded amplitudes, which corresponds to investigating a multimodal laser with non-synchronized modes and a single-modal laser. The study was carried out for both strong and also for weak fields, and showed a substantial difference in relaxation of the system depending on the type of modulation. This behavior can be used in experimentally investigating the statistics of laser radiation sources.

57352 Laser based on vapors of 1,4-di(2-benzoxazolyl)-benzene (BOPOB) and 2-(4-diphenylyl)-5-phenyloxazol (DPO). Borisevich, N.A.; Gorelenko, A.Ya.; Povedailo, V.A.; Tolkachev, V.A. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 332-337(Aug 1976). (In Russian).

A total of 20 compounds were investigated to determine light generation ability in the gas phase. Stimulated light was obtained from BOPOB and DPO with wavelengths 378 and 382 nm respectively. Pumping was achieved in the transverse variant by a nitrogen laser with a power up to 2 megawatts. A determination was made of the regions of tuning the light frequency of BOPOB (366 to 388 nm) and of DPO (383 to 422 nm).

57353 Spectral characteristics of light radiation from a double-discharge transverse, CO_2 laser. Blinov, S.I.; Zalesskaya, G.A.; Kotov, A.A. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 341-344(Aug 1976). (In Russian).

An experimental study was made of the spectral composition of light radiation from a pulse, transverse-discharge, CO_2 laser at various pumping energies, pressures and compositions of the working mixture. It is shown that this laser with typical energy and time characteristics and with a non-selective resonator radiates in a stable fashion the P(20) line of the 00°1-10°0 transition with a small contribution of the P(18) and P(22) lines. Use of an echelon diffraction grating as one of the resonator mirrors leads to light generation

only from a single rotational line, and also allows tuning of the light frequency over a wide range of both oscillatory-rotational laser transitions.

57354 Retuning the frequency in a semiconductor quantum generator having electron excitation. Goncharov, I.G.; Dedushenko, K.B.; Uzkii, A.F. *Zh. Prikl. Spektrosk.;* **25**: No. 2, 345-347(Aug 1976). (In Russian).

A report is given on tuning the frequency of a gallium arsenide, semiconductor laser having electron excitation by smoothly and discretely changing the width of the forbidden zone in the active region while shifting the electron beam over the sample. A description is given of the multilayer structure, on which a mode of light generation is obtained with a small number of longitudinal modes and with a low value of the threshold current density in layers having different amounts of aluminum impurity.

57355 Population inversions in atomic cesium in the Cs/F_2, Cs/NF_3, and Cs/ClF_5 reaction systems. Hall, L.H. (Rockwell International, Woodland Hills, CA). pp 178-182 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The Cs/F_2 reaction system was studied in order to determine its potential for an electronic transition laser. Cesium vapor was reacted with F_2 gas and the chemiluminescence was analyzed spectroscopically to find relative populations of the excited electronic states of Cs. T_0 for the system was found to be 1230°K. T_0 for Cs/NF_3 was found to be 1050°K while T_0 for Cs/ClFs was found to be 1200°K. (TFD)

57356 Excitation cross sections for metal ions. Collins, G. (Colorado State Univ., Fort Collins). pp 183-184 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Helium-metal vapor lasers constitute a new class of practical gas lasers. This classification includes He-Zn, He-Cd, He-Hg, He-Se, He-Te, He-Mg, He-As, and He-I_2. In all cases laser oscillation occurs in the atomic ion spectrum of the metal. Altogether more than one hundred cw laser lines have been generated spanning the wavelength region from 3250 A to 1.3 μm. Thus, for example, the He-Cd laser has the distinction of possessing the shortest wavelength cw laser transition at 3250 A, while the He-Se laser provides a total of 46 cw laser transitions in the spectral region between 4467 A and 1.26 μm. Nineteen Se II lines in the blue-green region have been observed to oscillate simultaneously. Application of these devices to Raman spectroscopy, holography, and broadband absorption spectroscopy is now common.

57357 Collisional relaxation of the copper ^{2}D/sub 5/2/ state. Trainor, D.W.; Ewing, J.J. (Avco Everett Research Lab., MA). pp 185-188 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The pulsed copper vapor laser was studied by a number of workers because of its potential high efficiency and power for a visible-light laser. Results of experimental measurements of the quenching rate constants for the collisional relaxation of the $3d^94s^2$ (^{2}D/sub 5/2/) metastable state of copper--the lower laser level for the 5106 A (green) laser transition are reported.

57358 Spectroscopy, kinetics, and performance of rare gas monohalide lasers. Brau, C.A.; Ewing, J.J. (Avco Everett Research Lab., MA). pp 195-198 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Recently, several rare gas monohalide species have been shown to lase on the transition $B^2SIGMA/sub\ 1/2/^+ \rightarrow X^2SIGMA/sub\ 1/2/^+$. These species include XeF (354 nm), KrF (249 nm), XeCl (308 nm), and XeBr (282 nm). The spectroscopy and kinetics of these lasers are discussed. Some results on the performance of the KrF laser are presented.

57359 XeBr excimer laser. Searles, S.K. (Naval Research Lab., Washington, DC). pp 199-203 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Laser emission was recently reported from e-beam excited $Xe-Br_2$ mixtures via the three-step mechanism: vector e + Xe → Xe^* + vector e, Xe^* + Br_2 → $XeBr^*$ + Br, and $XeBr^*$ → Xe + Br + h nu (282 nm). This work proved the existence of stimulated emission from a specific $Xe-Br_2$ mixture at one atmosphere total pressure. A complete study of $XeBr^*$ emission as a function of the partial pressure of Xe and Br_2 is presented. (TFD)

57360 Transverse electric discharge lasers in N_2^+ and XeF. Burnham, R. (Science Applications Inc., Arlington, VA); Harris, N.; Djeu, N. pp 204-206 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Superradiant stimulated emission in N_2^+ at 3914 and 4278 A and in XeF at 3511 and 3531 A excited in transverse electric discharges operating at total gas pressures between 0.4 and 4 atm is reported. Stimulated emission in the latter system has heretofore been obtained only with electron-beam excitation. (TFD)

57361 Modeling and gain measurements on the K-Xe excimer and dimer laser transitions. Palmer, A.J.; Fitzgerald, J.E. (Hughes Research Labs., Malibu, CA). pp 207-210 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The A to X transition on the diatomic alkali rare gas molecules (excimers) and the diatomic alkali molecules (dimers) are now well recognized as a potentially efficient, high average power, tunable laser transition. Results of modeling calculations and gain measurements on a flashlamp-pumped potassium-xenon system are presented. The model predicts net laser gain for this system on both the excimer and dimer bands under operating conditions presently being realized in the laboratory. The gain measurements indicate a relative gain of 25% per meter on the excimer band which is consistent with the model. (TFD)

57362 Three efficient e-beam pumped high power lasers: XeF, Ar-I_2, and KrF. Bradford, R.S. Jr.; Ault, E.R.; Bhaumik, M.L. (Northrop Research and Tech. Center, Hawthorne, CA). pp 211-213 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Rare gases are capable of converting e-beam energy into electronic excitation with very high efficiency. Such conversion may be employed in the development of efficient visible and near uv lasers by using energy transfer to a suitable laser molecule. The observation of three new laser developments which all initially involve e-beam excitation of a rare gas: (1) XeF quasi-excimer; (2) Ar-I_2 transfer; and (3) KrF excimer, is reported. (TFD)

57363 Fluorescence yield of the 340 nm band of e-beam pumped argon/iodine. McCusker, M.V.; Hill, R.M.; Huestis, D.L.; Lorents, D.C.; Gutcheck, R.A.; Nakano, H.H. (Stanford Research Inst., Menlo Park, CA). pp 217-220 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

A mixture of argon gas and iodine was excited by a relativistic electron beam. It was concluded that the emissions are molecular iodine electronic transitions between upper ionic and lower covalent states. While the present knowledge of the kinetic mechanism that populates these upper ionic states of I_2 is incomplete, an intermediate step involving dissociation of the iodine by the excited argon is plausible. (TFD)

57364 Laser action on the 342 nm molecular iodine band. Ewing, J.J.; Brau, C.A. (Avco Everett Research Lab., MA). pp 221-224 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

A new electron-beam pumped uv laser operating on the molecular iodine bands at 342 nm is reported. This laser was obtained by pulsed e-beam irradiation of noble gas mixtures containing primarily Ar buffer gas and trace amounts of the iodine-containing species HI and CF_3I. Laser action was obtained from Ar mixtures containing Xe. (TFD)

57365 Electronic transition CN laser pumped by a pulsed electric discharge. Quick, C.R. Jr.; Wittig, C. (Univ. of Southern California, Los Angeles). pp 224-227 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The first report of an electronic transition CN laser was by Berry and co-workers in a series of well controlled and elucidating

experiments. In their experiments, flash photolysis was used to dissociate CN-containing compounds and the CN fragment was most frequently liberated in the A^{2}PI/sub i/ state. Stimulated emission was observed on the (0, 0), (0, 1) and (0, 2) bands of the A-X system. A-X stimulated emission using straightforward electric discharge excitation is reported. This has significant technological implications with respect to producing a high power and efficient electronic transition laser based on CN. (TFD)

57366 Cyanide radical molecular electronic laser: grating selection determination of population inversions. Knudtson, J.T.; Berry, M.J. (Univ. of Wisconsin, Madison). pp 228-234 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The cyanide radical (CN) has a long spectroscopic and chemical kinetic history. It is readily produced in flames, electric discharges, and flash photolysis. The grating selection technique and results of the measurements are described. (TFD)

57367 Kinetic study of N_2(B^{3}II/sub g/, v) quenching utilizing laser-induced fluorescence. Heidner, R.F. III; Sutton, D.G.; Suchard, S.N. (Aerospace Corp., El Segundo, CA). pp 235-243 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Recent experiments have established that SF_6 has a pronounced effect on the energy output, pulse duration, and line sequencing of the N_2 second-positive, first-positive, and W^{3}DELTA/sub u/ → B^{3}PI/sub g/ transition lasers. These complex phenomena suggested that SF_6 was removing the lower laser level of the near ultraviolet C^{3}PI/sub u/ → B^{3}PI/sub g/ transition. In order to test this hypothesis, a kinetic study of the B^{3}PI/sub g/, v = 0 and v = 1 levels was undertaken which has focused on the quenching efficiencies of SF_6, N_2, and Ar.

57368 Spectral and temporal behavior of the N_2/SF_6 2nd positive laser. Sutton, D.G.; Heidner, R.F. III; Suchard, S.N. (Aerospace Corp., Los Angeles). pp 244-247 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Sulfur hexafluoride has been shown to enhance the excitation of the nitrogen second positive bands in laser emission. When it is added to pin discharges of nitrogen the 3371 and 3576 A lines can be excited despite the relatively slow risetime of the resistively loaded circuit. The ultraviolet emission from this device is sensitive to cavity alignment and exceeds in duration the C^{3}PI/sub u/ radiation lifetime. Sulfur hexafluoride is seen to quench the first positive laser emission from the pin discharge when present in quantities sufficient to provide gain on the ultraviolet laser. The B^{3}PI/sub g/ state of nitrogen is common to both laser systems serving as the upper level of the first positive and lower level of the second positive. The effect of SF_6 on the B state is concluded to be crucial to the behavior of the N_2-SF_6 second positive laser.

57369 Formation of electronically excited products in chemical reactions: an information theoretic analysis. Levine, R.D. (Univ. of Texas, Austin). pp 251-267 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The general factors that govern the distribution of reaction products among the electronic states that are energetically accessible are examined. (TFD)

57370 Lower electronic states of Zn_2. Hay, P.J.; Dunning, T.H. Jr.; Raffenetti, R.C. (Los Alamos Scientific Lab., NM). pp 268-271 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Some of the more promising systems for visible and uv lasers include the class of molecules such as Hg_2, Zn_2, and the rare-gas dimers, which have essentially dissociative ground states but bound electronic excited states. For these systems there is currently little experimental knowledge of the potential energy curves involved in these processes. In an attempt to provide a better theoretical understanding of the Zn_2, Cd_2 and Hg_2 series, the Zn_2 system was chosen as a model in this study.

57371 Electronic states of argon oxide. Dunning, T.H. Jr. (Los Alamos scientific Lab., NM); Hay, P.J.; Raffenetti, R.C. pp 272-277 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The rare-gas oxides have attracted interest because of the demonstration of lasing on the O(^{1}S) → O(^{1}D) transition (5577 A) in argon-, krypton-, and xenon-oxygen mixtures. Of particular relevance for the rare-gas/oxygen systems are the electronic states of the rare gas oxide, the collision-induced emission of the O(^{1}S) → O(^{1}D) dipole-forbidden transition, and the quenching of O(^{1}D) to O(^{3}P). A brief summary of ab initio configuration interaction (CI) calculations on the electronic states of ArO arising from Ar(^{1}S) + O(^{3}P, ^{1}D, and ^{1}S) is reported. (TFD)

57372 Electronic structure and radiative lifetimes for BO. Michels, H.H. (United Technologies Research Center, East Hartford, CT); Harris, R.; Lillis, J. pp 278-280 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Detailed quantum calculations were carried out for all of the low lying electronic states connecting to B(^{2}P) + O(^{3}P) and B(^{2}P) + O(^{1}D). These studies included examination of states of symmetry ^{2}SIGMA$^+$, ^{2}SIGMA$^-$, ^{4}SIGMA$^+$, ^{4}SIGMA$^-$, ^{2}PI, ^{4}PI, ^{2}DELTA and ^{4}DELTA. Accurate configuration-interaction wavefunctions were constructed for these states and a comparison of calculated potential curves with experimental RKR curves has been carried out. A systematic calibration of the calculated curves has been performed to empirically correct for core polarization effects which were not included in the wavefunction expansion. An analysis of the radiative lifetimes of the low lying states of BO has been carried out. The allowed transitions B^{2}SIGMA$^+$ → X^{2}SIGMA$^+$, B^{2}SIGMA$^+$ → A^{2}PI and A^{2}PI → X^{2}SIGMA$^+$ have been examined in detail and estimates of the lifetime of the quartet system have been made. The a^{4}SIGMA$^+$ → A^{2}PI electronic transition at about 5000 A looks very promising for pulsed laser operation in this system.

57373 Interpretation of probabilities calculated for the quenching of Br(^{2}P/sub 1/2/) by H_2, HD, and D_2 for collinear collisions. Zimmerman, I.H.; George, T.F. (Univ. of Rochester, NY). pp 279-285 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Before initiating atom-diatom scattering calculations it is necessary to choose a model for the collision system. This choice will entail a greater or lesser degree of approximation, depending on how accurate the model must be in order to fulfill the purpose of the calculation, but depending also on the availability of resources for carrying out the work. The collinear approximation is frequently used in cases where vibrational response of the diatom to impact by the incident atom is of interest. Unfortunately, this approximation in its usual form does not provide information that can be checked experimentally except in a qualitative way. This drawback is somewhat corrected by introducing the lozenge model.

57374 Extension of spin and symmetry restrictions to carry ghost information: a new theoretical principle governing probability of asymmetric charge on electronic energy exchange. Kaufman, J.J. (Johns Hopkins Univ., Baltimore). pp 286-292 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The extra "ghost" information makes it possible to predict how to form electronically excited species for lasers for both light-atom and heavy-atom systems, including those for which conventional symmetry and spin restrictions are not capable of permitting such a determination. (TFD)

57375 Theory of electronic excitation in chemical laser reactions. Huestis, D.L. (Stanford Research Inst., Menlo Park, CA). pp 293-295 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

It is suggested that most of the observed chemiluminescence arises from one or both of two sources: (1) statistical (i.e., nonpreferential) population of electronic states in a long-lived reaction complex; or (2) statistical population of electronic states by collisional transfer from initially produced high vibrational levels of the ground-state product. The observation of maximum photon yields at finite background gas pressures suggests that mechanism 2 is the most important. (TFD)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 56340, 56596

57376 (AD-A—049437) **Heat transfer over a vertical melting plate.** Yen, Y.; Hart, M.M. (Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Dec 1977. 20p. (CRREL—77-32). NTIS PC A02/MF A01.

An experimental study of forced convective heat transfer over a vertical melting plate has been conducted. This study covers water velocities ranging from 1.7 to 9.8 mm/s and bulk water temperatures from 1.11 to 7.50 C. The experimental results are correlated in terms of Nusselt, Prandtl and Reynolds numbers with a moderate correlation coefficient of 0.843. The results are expected to be useful in predicting the heat transfer characteristics of a much larger prototype ice-water heat sink.

57377 (SAND—78-1360C) **Finite element analysis of several standard flow problems.** Gartling, D.K. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1978. Contract EY-76-C-04-0789. 18p. (CONF-780712—5). Dep. NTIS, PC A02/MF A01.

From Conference on numerical methods in laminar and turbulent flow; Swansea, UK (18 Jul 1978).

The comparison of various numerical methods in their performance on standard test problems can provide a large quantity of useful information for individuals involved in the area of computational fluid dynamics. Though it is impossible to completely quantify all aspects of computer code performance, the results from various test problems can provide substantial guidance to code users in the choice of a method and to code developers in the choice of research and development areas. As a part of the International Conference on Numerical Methods in Laminar and Turbulent Flow (Swansea, Wales 1978), a series of six standard problems were developed. Results obtained from a finite element computer program for three of the test problems are presented.

57378 (UCRL—81323) **Time-dependent FEM solution of the incompressible Navier—Stokes equations in two- and three-dimensions.** Gresho, P.M.; Lee, R.L.; Sani, R.L.; Stullich, T.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jul 1978. Contract W-7405-ENG-48. 59p. (CONF-780712—7). Dep. NTIS, MF A01.

From Conference on numerical methods in laminar and turbulent flow; Swansea, UK (18 Jul 1978).

Portions of document are illegible.

Future prospects regarding the numerical solution of the Navier-Stokes equations using the finite element method are discussed. Since the ultimate goal is to solve these equations in three-dimensions, only the primitive variable (u,P) formulation is considered. A novel feature of the two-dimensional solution technique relates to the methodology developed and employed for solving the semi-discretized system of ordinary differential equations, which are outlined in the section describing the development of the two-dimensional code. Following the discussion of numerical results from two-dimensional calculations, three-dimensional flows are discussed, where several potentially viable options are considered. (TFD)

57379 **Heat exchange between a selectively radiant liquid and a heat-conducting, laminar, gas stream in the presence of an external radiation source.** Rubtsov, N.A.; Shvariburg, A.M. *Zh. Prikl. Mekh. Tekh. Fiz.;* No. 3, 116-122(1976). (In Russian).

This study considers radiative and complex heat exchange between a selectively radiant liquid and a transparent, heat-conducting laminar gas flow with a given external field of thermal radiation. Energy conservation equations are set up with the transfer of heat by radiation, convection and molecular heat conduction being taken into account. A differential approximation is used in calculating radiative flow values. The set of basic calculational equations is solved by the method of finite differences and iteration, and by the Runge-Kutta method. The results of the calculations are presented graphically.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 56920, 57437

57380 (BNWL-SA—6088(Rev.)) **Automatic high-speed process control/quality assurance monitor.** Coleman, W.J.; Swinth, K.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 24p. (CONF-780484—1). Dep. NTIS, PC A02/MF A01.

From 3. automated inspection and product control conference; Nottingham, UK (11 Apr 1978).

Battelle, Pacific Northwest Laboratories has developed an advanced cartridge case measurement/eject system (CCMES) which automatically inspects and rejects cases up to 1200 per minute. The system consists of a mechanical handler, measurement instruments, and a dedicated computer. System operation is monitored and controlled while the product is being measured. Five case dimensions are measured by an electro-optical system using diode arrays to measure a case image at unity magnification. By scan averaging, measurement standard deviations as small as 2.5 μ are obtained at a throughput of 1200 cases per minute. Measurements made with the system fall within the uncertainties of hand-gauged values for the same cases. Four zones on each case are examined for surface flaws, such as dents and scratches, by detecting light scattered from the surface. The system can detect these surface flaws at inspection rates of 1200 cases per minute. Using electro-optic methods, two additional measuring stations detect vent hole presence and gross size deviations to prevent mechanical jams. A third station employs an eddy current technique to detect splits and folds in critical regions of the cartridge case. The overall system has passed quality assurance tests administered by the sponsor and will soon be installed at the Lake City Army Ammunition Plant.

57381 (EPRI-NP—761) **Evaluation of ultrasonic techniques for detection of stress-corrosion cracks in stainless steel piping. Key Phase report.** Kupperman, D.S.; Reimann, K.J.; Ellingson, W.A. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 101p. Dep. NTIS, PC A06/MF A01.

Ultrasonic pulse-echo techniques for detecting intergranular stress-corrosion cracking in 102-, 254-, and 660-mm Type 304 stainless steel Schedule 80 piping are evaluated. The effectiveness of a variety of ultrasonic transducers is compared. Transducers with varying frequency, size, and beam angle were used. Focused, nonfocused, and single- and dual-angle-beam transducers were also tested. In addition, curved and flat transducer wedges were compared. Artificial reflectors of varying size and orientation were employed in both welded and unwelded pipes to establish flaw-detection reliability and sensitivity. Data from welded pipe sections with laboratory-grown and field-induced intergranular cracks are also presented. Some statistical data for establishing the probability of detection of small reflectors are presented for artificial reflectors in 102-mm pipes and small stress-corrosion cracks in 254-mm pipes. Problems associated with spurious ultrasonic signals resulting from weld geometry are discussed.

57382 (LA-UR—78-1543) **Digital interface for NDT instruments.** Strong, R.D. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

In order to obtain access to a computer from ordinary NDT instruments, a special interface was made which acts as the buffer between the computer, and the real world. The special purpose interface, which was designed and built by Group M-1 of the Los Alamos Scientific Laboratory is described. This interface was primarily built for use with various ultrasonic equipment, but is actually a general purpose system that can perform data acquisition and control for other tests.

57383 (PNL-SA—6472) **Eddy current system for high speed inspection of M-16 cartridge cases.** Dilbeck, R.A.; Davis, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1978. Contract EY-76-C-06-1830. 19p. Dep. NTIS, PC A02/MF A01.

An eddy current system developed to detect cracks, splits, and folds in 5.56 mm cartridge cases at a rate of 1200 cases/minute is described. The system inspects each cartridge case around its entire circumference, and has an operating frequency of 100 kHz which minimizes sensitivity to wall thickness variations. Also discussed is the use of the instrument to monitor cartridge case wall thickness by reducing the operating frequency. At a frequency of 25 kHz, wall thickness can be measured with an accuracy of 0.013 mm (0.0005 in.). Maximum, minimum, and average wall thickness is simultaneously recorded for each case about its circumference at four different locations on the case. Also described are some rather unique features of the electronic instrument. These include an oblong search coil which is contoured to cartridge case motion, a temperature stabilization method based on constant current excitation of send-receive coils, and a rapid automatic nulling technique employing digital methods. Additionally, a method for using a Q-multiplier as either an oscillator or a bandpass filter is described. The method facilitates the use of a bandpass filter that is precisely matched to the eddy current signal generator so that no output phase error occurs during minute drifts in test frequency.

57384 (UCRL—80725) **Noncontact material testing using laser energy deposition and interferometry.** Calder, C.A.; Wilcox, W.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1978. Contract W-7405-ENG-48. 27p. (CONF-780912—1). Dep. NTIS, PC A03/MF A01.

From 6. conference on experimental stress analysis; Munich, F.R. Germany (18 Sep 1978).

A technique is described for the noncontact testing of materials using laser deposition to generate a stress pulse and interferometry to record the transient surface displacement. The dilatational wave speed can be measured and, in the particular case of rod or plate specimens, sufficient information can be obtained to evaluate the two elastic constants of an isotropic material. Several applications illustrating the advantages of the approach are summarized.

SAFETY ENGINEERING

REFER ALSO TO CITATION(S) 57471

VACUUM ENGINEERING

57385 Response of the pressure in an elementary vacuum system. Edwards, D. Jr. (Brookhaven National Lab., Upton, NY). *Vacuum;* 27: No. 12, 631-634(1977).

A simple vacuum system consisting of a volume V(l), a wall, a real pump S(l.s^{-1}) and a gas leak L is considered. The system gas is allowed to interact with the wall via a single adsorption state characterized by a sojourn time tau/sub w/ and a wall pumping speed S/sub w/ (l.s^{-1}). Within this model, the response in time of the system pressure to a pumpdown, to a sudden change of L, and to a sudden change of S is evaluated. It is shown that these three cases can be described in terms of a single function containing all of the gas-wall interaction parameters and expressions for this function are derived for two situations of interest; i.e., S/S/sub w/ much less than 1, and tau/sub s//tau/sub w/ much less than 1, where tau/sub s/ = V/S. In addition, the change in dp/dt at t = 0 due to a sudden change in the real pumping speed by an amount ΔS(l.s^{-1}) is shown to be $p_0\Delta S/V$, p_0 being the pressure at t = 0. It is noted that this result is in fact independent of the details of the gas-wall interaction processes.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 57382

57386 (BDX—613-1887(Rev.)) **Process effects on high voltage electrical assembly performance. Final report.** Cummings, D.A. (Bendix Corp., Kansas City, MO (USA)). Aug 1978. Contract EY-76-C-04-0613. 12p. Dep. NTIS, PC A02/MF A01.

Manufacturing processes and package configurations that affect the operation of some high voltage electrical assemblies have been evaluated. High voltage breakdown, adhesion problems, and encapsulated component and solder joint breakage have been relieved by improvements in residue analysis, cleaning and coating techniques, and stress relief coatings. A quantitative comparison of encapsulated lead stress relief systems has been completed to determine their effect on both component and solder joints during thermal cycling of encapsulated electronic assemblies. Evaluations have been conducted involving printed circuit board substrates with thermal expansion equal in all directions. A qualitative solder joint thermal cycle study was conducted to compare the effects of encapsulant, lead loops, and sleeving on solder joint failure.

57387 (BDX—613-1920(Rev.)) **Temperature versus time curves for manual and automated soldering processes.** Trent, M.A. (Bendix Corp., Kansas City, MO (USA)). Aug 1978. Contract EY-76-C-04-0613. 52p. Dep. NTIS, PC A03/MF A01.

Temperature-versus-time curves were recorded for various electronic components during pre-tinning, hand soldering, and drag soldering operations to determine the temperature ranges encountered. The component types investigated included a wide range of electronic assemblies. The data collected has been arranged by process and will help engineers to: (1) predetermine the thermal profile to which various components are subjected during the soldering operation; (2) decide—on the basis of component heat sensitivity and the need for thermal relief—where hand soldering would be more feasible than drag soldering; and (3) determine the optimum drag solder control parameters.

57388 (BDX—613-2028) **Contaminant detection, characterization, and removal based on solubility parameters.** Jackson, L.C. (Bendix Corp., Kansas City, MO (USA)). [nd]. Contract EY-76-C-04-0613. 7p. (CONF-780907—3). Dep. NTIS, PC A02/MF A01.

From 4. conference on contamination; Washington, DC, USA (10 Sep 1978).

Surface cleanliness, in the past, has generally been evaluated indirectly by adhesion or electrical tests. As cleanliness requirements for electrical parts increase, contamination detection and removal become more critical. Using the relatively new technologies of evaporative rate analysis and solubility parameter, a new approach to surface cleanliness has been achieved. Based on the principles of solubility parameters, compatibility of contaminants with solvents is described. Greater accuracy in solvent selection can be achieved when solvents are classed according to their hydrogen bonding potential. Blending solvents according to solubility parameter principles permits specific solubility sharacteristics to be obtained for specific contaminant removal. The swell index of plastics also follows solubility parameter principles of solvent compatibility. Surface measurements by the evaporative rate analysis technique permit contaminant detection as low as 0.1 microgram for each 1.0 square centimeter of surface area. Using surface energy probes of various polarity levels, surface characterization can be achieved. Application of four-quadrant chart analyses serves as a means of surface characterization. The surface electrical properties of contaminants (surface leakage and arc over) can be shown to relate to the various levels of polarity- nonpolarity of materials. This work now permits actual measurement of surface cleanliness.

57389 (SAND—78-1278) **Signal-processing analysis of the MC2823 radar fuze: an addendum concerning clutter effects.** Jelinek, D.A. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

A detailed analysis of the signal processing of the MC2823 radar fuze was published by Thompson in 1976 which enabled the computation of dud probability versus signal-to-noise ratio where the noise was receiver noise. An addendum to Thompson's work was published by Williams in 1978 that modified the weighting function used by Thompson. The analysis presented herein extends the work of Thompson to include the effects of clutter (the non-signal portion of the echo from a terrain) using the new weighting function. This extension enables computation of dud probability versus signal-to-total-noise ratio where total noise is the sum of the receiver-noise power and the clutter power.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 56459, 56461, 56537, 57141

57390 (FE—2471-15) **Industrial application fluidized bed combustion. Category III. Indirect fired heaters. Quarterly technical report No. 5, July 1—September 30, 1977.** Cherrington, D.C.; Diener, R.; Golan, L.P.; Weiner, S. (Exxon Research and Engineering Co., Florham Park, NJ (USA). Engineering Technology Dept.). 15 Nov 1977. Contract EX-76-C-01-2471. 42p. Dep. NTIS, PC A03/MF A01.

A program has been initiated to evaluate the technical and economic potential for the application of fluidized bed combustion technology to refinery and petrochemical plant indirect-fired process heaters. The strategy for the program is to build on the available boiler-oriented FBC technology. Areas common to both steam generating boilers and process heaters will not be intentionally advanced by this program. However, the results of complementary programs in the boiler area will be considered in the assessment of potential heater applications. Two pertinent areas not being addressed in the on-going boiler oriented programs and which are being investigated here concern the effects of larger tube size and hydrocarbon coking. Phase I of the program consists of the design, construction and operation of three laboratory facilities to carry out these studies. Fluidized bed performance studies have been completed on tube bundle arrays of 2-inch and 6-inch diameter tubes and with tubes on nominal 2-diameter, 3-diameter and 4-diameter horizontal spacing. Conductive/convective heat transfer coefficients as a function of tube size, location and surface orientation have also been obtained on these same bundle configurations and on isolated single tubes. A Process Stream Coking Test Unit has been assembled to study the primary process parameters affecting coke laydown on the internal surfaces of hydrocarbon containing tubes. Design and preliminary planning is complete for the third laboratory facility which will be a coal-fired, fluidized-bed combustor. This facility will be used to study overall heat transfer coefficients and combustion performance.

57391 (HCP/T2461—07) **Industrial application of fluidized bed combustion. Quarterly technical progress report for the period, January—March 1978.** (Georgetown Univ., Washington, DC (USA)). Jul 1978. Contract EX-76-C-01-2461. vp. Dep. NTIS, PC A02/MF A01.

In line with a determination by the Federal Government that a fluidized-bed combustion process can efficiently convert the energy of coal to usable power in an environmentally acceptable manner, Georgetown University was awarded Letter Contract E(49-18)2461 by the then Energy Research and Development Administration (now Department of Energy - DOE) to construct and operate a demonstration plant. The Letter Contract was replaced by Contract EX-76-C-01-2461. This report, the sixth quarterly progress report under the contract, reflects the significant progress made on plant

construction, boiler fabrication, award of prepurchased equipment, shop drawing review and approval, and redesign to meet requirements of equipment shop drawings.

57392 Method and apparatus for the combustion of gasoline or liquid fuels. Rybar, V.; Drapal, R.; Kabelik, R. (to Stav, Praha, vyrobni stavebni druzstvo stredisko Monta). US Patent 4,090,476. 23 May 1978. Priority date 18 Nov 1975, Czechoslovakia. 8p.

A preheated fuel-air mixture is subjected to the following sequential steps: it is ignited, the flame is scanned, the burning mixture is introduced onto the free upper level of a radiation substance charge which is then passed along first heat exchange surfaces, a glowing flameless combustion zone is produced in said charge; beyond said zone the combustion gases are passed along second heat exchange surfaces of an increased area relative to the first heat exchange surfaces, with changed rate of flow. The apparatus is equipped with an ignition and flame scanning gap above said charge and with heat exchange tubes which are divided into several branches past said glowing combustion zone.

57393 Effect of air swirl on combustion in fuel beds. Nag, P.K.; Mukherjee, S.G. (IIT, Kharagpur, India). *J. Inst. Eng. (India), Mech. Eng. Div.;* **58**: 159-163(Jan 1978).

From Annual paper meeting; Calcutta, India (20 Nov 1977).

Imparting of swirl to the air supplied for combustion in fuel beds enhances the burning rate considerably. For given experimental data for average combustion rates at different air flow rates under steady air flow condition, probable increase in the burning rate due to incorporation of swirl can be predicted, provided the magnitude of the swirling torque is known. The maximum deviation of the predicted results from the experimental values is found to be 21 percent.

57394 Estimation of torque imparted to air by vane swirlers. Nag, P.K.; Mukherjee, S.G. (IIT, Kharagpur, India). *J. Inst. Eng. (India), Mech. Eng. Div.;* **58**: 164-166(Jan 1978).

From Annual paper meeting; Calcutta, India (20 Nov 1977).

Swirling jets are widely used in combustion appliances to promote mixing and burning of fuel. They can also be used to enhance the rate of heat transfer. A method is suggested to estimate theoretically the swirling torque imparted to the fluid. An experimental technique for swirl torque measurement is also discussed. The deviation of the estimated torque from the measured torque was within 7.0 percent for swirlers with 17.5 cm vane length and 14.7 percent for swirlers with 10 cm vane length.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 56415, 56416, 56417, 56574

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 56475, 56476, 56477, 56478, 56523, 56524, 56525, 56526, 56527, 56529, 56533, 56534, 56549, 56567, 56568, 56569, 56570, 56571, 56572, 56573, 56575, 56576, 56577, 56578, 56579, 56580, 56581, 56582, 56583, 56584, 56585, 56586, 57312, 57657, 57660, 57664

57395 Water impact loads and dynamic response of horizontal circular cylinders in offshore structures. Faltinsen, O.; Kjaerland, O.; Noettveit, A.; Vinje, T. (Norwegian Inst. of Tech., Oslo). pp 119-126 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Model test results and numerical calculations of water impact loads on rigid horizontal circular cylinders are presented. The initial slamming force-coefficient C/sub S/ is numerically estimated to be 3.1. Experiments give an average value of 5.3. The time history of the water-induced load is examined. Dynamic response of three-dimensional elastic models of horizontal trusses of semisubmersibles and jackets are studied. Scaling of model test results result in significant stresses for realistic wave velocities in the North Sea.

57396 Wind tunnel hydrodynamic testing of a large submersible vehicle model. Van Ryzin, J.C. pp 127-132 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

During the development of a large (270 ton) underwater remote-controlled vehicle, it became essential for the control design that tests be conducted to determine the steady state hydrodynamic drag characteristics of the submerged vehicle. Such a large complex shape is difficult, if not impossible, to model with the correct Reynolds number in water because of the huge drag and power requirements. Testing of this vehicle was done in a wind tunnel with almost exact Reynolds number correlation. Air can be used for testing of underwater vehicles as long as the fluid is reasonably incompressible (low speeds), there is no free surface and no cavitation; it is also advantageous if the flow is not critical. If the model is sized to conveniently fit into the wind tunnel test section, the required air velocity to reach the appropriate Reynolds number is within the approximate incompressible range (approximately 330 ft/s) and the test forces are within the test facility balance range, then the vehicle can be conveniently tested in a wind tunnel. This particular vehicle was tested at various roll, yaw and pitch angles to evaluate six-component forces and moments. Reynolds number effects, support tare and vehicle configuration changes were studied. The results of the test provided invaluable information for an accurate evaluation of the vehicle maneuverability and handling characteristics. Larger than expected roll moments and lift forces were encountered and compensating vehicle control design changes were made. Wind tunnels offer an excellent alternative and, in many cases, a better alternative than testing the vehicle in water or relying solely on an analytical solution.

57397 Effect of various spectral formulations in predicting responses of marine vehicles and ocean structures. Ochi, M.K.; Bales, S.L.; Taylor, D.W. pp 133-148 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In order to examine the effect of wave spectral formulations on the magnitude of responses of marine vehicles and ocean structures, several wave spectra, including Pierson-Moskowitz, Bretschneider, Six-parameter, JONSWAP, etc., are selected, and computations of responses in a seaway are carried out. Responses to several hundred available wave spectra measured at various locations in the world are also included in order to provide guide lines for use of spectral formulations in design evaluations. Computations are made for four different ship types and one ocean platform, and the effect of heading to waves and speed are included in some examples.

57398 Statistical decision basis for obtaining additional information for the design of offshore platforms. Benjamin, J.R.; Reed, J.W. pp 167-176 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Information is presented to explain and demonstrate how statistical decision theory can be used to determine the optimal level of structural capacity for a proposed offshore platform. This type of analysis can be used to decide whether additional information concerning the likely future hazard environment of a proposed offshore platform should be obtained. This use of statistical decision theory is the main focus of the following discussion. A proposed platform at an offshore southern California site in the vicinity of Tanner Bank has been chosen as an example to demonstrate statistical decision analysis procedures. The problem considered is that of deciding whether to obtain additional information concerning earthquake ground motion and ocean wave characteristics in the Tanner Bank area before deciding how strong to build an offshore platform. IF it is decided to obtain additional data, the next step is to define the optimum experimental of investigative program considering the data to be obtained, the cost, and the value to be received. This problem is complex and the decision must be based on all uncertain aspects of the future.

57399 Extending seismic design provisions for buildings to the design of offshore structures. Sharpe, R.L.; Newmark, N.M. pp 177-184 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The philosophy and background of seismic design provisions for buildings are discussed. The applicability of design assumptions and provisions used for buildings to extremely tall, slender, and flexible offshore structures is reviewed. Offshore structures are much bigger in plan than most buildings and do not have a common foundation. Hence they may respond in torsion as well as translation to seismic motions. Moreover they are surrounded by water that causes different types of actions and response to dynamic inputs. The significance and possible effects on off-shore structures of major earthquake motion characteristics are presented. Areas that require detailed study are described.

57400 Considerations for analysis and design of piled offshore structures in severe earthquake environment. Kallaby, J. (Brown and Root, Inc., Houston, TX). pp 185-187 of Ninth annual offshore

technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In the past several years special consideration was given to the underlying philosophy of designing offshore platforms in earthquake environment. Current guidelines are based on the dual earthquake criteria: the Strength (Operating) and the Ductility (Safety) Levels. The Strength Level requires analysis and design techniques that have already been developed and can be used with reasonable confidence. Ductility Level analysis and design techniques are presently being formulated. Design guidelines are proposed intended to provide adequate performance in the post elastic range such that ductility analysis may not be required except in special cases.

57401 Study of soil—pile—structure systems in severe earthquakes. Arnold, P. (Shell Development Co., Houston, TX); Bea, R.G.; Idriss, I.M.; Reimer, R.B.; Beebe, K.E.; Marshall, P.W. pp 189-202 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A state-of-the-art review of the needs and problems involved in developing improved methods of inelastic dynamic analysis of offshore soil-pile-structure systems subjected to extreme earthquake shaking has been completed. It is concluded that development of a design-oriented computer code for three-dimensional, nonlinear dynamic analysis of fully coupled offshore soil-pile-structure systems is warrented. Complementary studies of several components of the system model are also required in order to develop user guidelines for parameter selection. The results of this review and a proposed course of action in terms of superstructure and substructure modeling strategy, computer code structure, and parameter selection are described.

57402 Seismic-resistant design of piping, equipment, and appurtenances for offshore structures. Kost, G.; Sharpe, R.L. pp 203-214 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The requirements and procedures for seismic-resistant design of offshore structures are receiving increased attention as sites are selected in seismically-active zones, and emphasis is usually on the basic structure. Of major importance to the entire facility, however, are the seismic design procedures used for piping, equipment, and appurtenances essential to operation and safety. Conventional static approaches used in some building codes generally neglect dynamic interaction between components and their supporting structure and therefore are often inadequate. The paper provides a general overview of procedures which account for this dynamic interaction and which have been successfully applied to many types of facilities, including hazardous industrial facilities, nuclear plants, hospitals, conventional buildings, and offshore structures. The basic engineering principles of these procedures are applicable to all types of facilities, and only the details must be tailored to meet specific design and performance requirements.

57403 Analytical methods for determining the ultimate earthquake resistance of fixed offshore structures. Gates, W.E.; Marshall, P.W.; Mahin, S.A. pp 215-226 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The need for reliable and reasonably accurate methods for predicting the ultimate earthquake resistance of tubular steel fixed offshore platforms has become increasingly evident. A realistic nonlinear dynamic time domain response analysis of an example structure is presented and compared with three simplified methods for determining ultimate earthquake resistance. These simplified methods include ductility modified response spectrum, ductility evaluation under equivalent static loads, and reserve energy technique.

57404 Reliability analysis of subsea control pod. Brown, R.; Satterwhite, L. pp 339-346 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A subsea production control pod was withdrawn from service, disassembled and analyzed to evaluate pod design. The results are examined and information derived is compared with results of other work toward improved pod reliability. Photographs show condition of the pod, effects of marine growth, and condition of internal components after an extended period of subsea operation. Information presented may be useful in evaluating future design, materials and component development, and may affect pod configuration and operating/service criteria for future subsea control systems.

57405 Review of reliability and performance of subsurface safety valves. Purser, P.E. pp 357-370 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Available data from USGS failure records for the Gulf of Mexico, API-sponsored tests at two universities, manufacturer's field tests, and various published sources have been reviewed and analyzed from a systems veiwpoint. The results indicate that surface-controlled subsurface valves have had higher failure rates than the simpler subsurface-controlled valves. One specific configuration of subsurface-controlled valve employing an annular (rather than circular) orifice and seating surface exhibited order-of-magnitude improvements both in setting accuracy and in resistance to sand cutting. Present USGS regulations on SSSV installation and test rquirements appear to need review and revision based on systems analyses of the existing data and valve-usage practices.

57406 Deep ocean mining: technology transfer from and to the offshore drilling industry. Williams, D.W.; McBride, C.M.; Kinnaman, S.C. pp 395-402 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In late 1977, a dynamically stationed drillship, SEDCO 445, will be used in the North Pacific Ocean to deploy equipment for recovering 5000 short tons of manganese nodules. This pilot test will be conducted in 5300 meters of water for an international consortium and will utilize many proven designs and techniques of the offshore drilling industry. These proven techniques and some of the newly designed methods will be presented in this paper to emphasize the desirability of a continuation of technology transfer between this newly emerging mining industry and the existing offshore drilling industry.

57407 Nonlinear dynamic analysis of coupled axial and lateral motions of marine risers. Bennett, B.E.; Metcalf, M.F. pp 403-412 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Deep-ocean mining systems are calling on the technology of marine petroleum operations, and many principles of petroleum riser design apply to mining applications. The long, freely suspended riser configuration of petroleum applications can be developed during the emergency disconnect maneuver; this configuration could apply as well to a mining-type riser. Analysis of riser performance in this configuration in one application serves the other as well. Long, freely-suspended riser columns can have dynamic stability problems under certain conditions. A mathematical model and solution technique are described that have been used to simulate in time the dynamic axial and lateral responses of such riser columns. When used in conjunction with closed-form stability analysis, the dynamic solutions provide valuable stability information of realistic configurations. Stability analysis by time series solution is inefficient. Improved solution techniques appropriate for stability analysis should be developed if exhaustive stability investigations are to be done.

57408 Engineering properties of calcareous soils affecting the design of deep penetration piles for offshore structures. Agarwal, S.L.; Malhotra, A.K.; Banerjee, R. pp 503-512 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Geotechnical investigations were carried out at three sites offshore India. The carbonate content varied in a wide range from 15 to 96%. A study, based on laboratory and field tests, was conducted to understand the effect of varying percentage of carbonate content on the engineering properties of deep penetration piles. Laboratory tests included to study stress-strain characteristics of calcareous soils, the effect of bentonite on soil-grout interface, effect of cyclic load and sensitivity whereas field tests data were analyzed to understand the effect of soil set-up as a function of time on the driving resistance and ultimate static capacity of the pile. Based on this experience, suggestions are incorporated to modify the limiting values of unit frictional resistance and end bearing for deep penetration piles in calcareous soils.

57409 Wave loads on North Sea gravity platforms: a comparison of theory and experiment. Garrison, C.J.; Stacey, R. pp 513-524 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

This paper deals with the wave loading of several North Sea gravity platforms. A procedure based on diffraction theory and the Morison equation is outlined for determination of wave loads on practical platform configurations. The procedure is applied to several platforms proposed for the North Sea and calculations are compared with model test results. Also, a simplified diffraction theory which uses an approximate Green's function is compared with the general diffraction theory.

57410 Nonlinear motion response of floating structures to wave excitation. Natvig, B.J.; Pendered, J.W. pp 525-536 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The linearized and non-linear motion response of floating structures to regular waves is described. Special emphasis is placed on taut line moorings and linearized and non-linear response curves are shown for a version of the Aker Tethered Production Platform. The motion response of conventional semisubmersibles is also discussed and response curves for the Aker H3 are shown. The linearized frequency domain method of analysis and the non-linear time history method are briefly discussed. An approximate method for solving the non-linear equations of motion based upon a Newton-Raphson type solution is proposed. This method, which is only valid for near linear systems, is shown to have practical applications for floating structures.

57411 Influence of internal waves on deepwater drilling operations. Osborne, A.R. (Exxon Production Research Co., Houston, TX); Brown, J.R.; Burch, T.L.; Scarlet, R.I. pp 537-544 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Shipboard observations during deepwater drilling operations by the Discoverer 534 and a simultaneous oceanographic measurement program have confirmed the presence of large internal waves in the Andaman Sea, offshore Thailand The Discoverer 534 has provided measurements of drillship response to internal wave activity in water ranging from 1900 ft to greater than 3400 ft; internal wave currents as high as 2.6 knots have been measured. As a result of the analysis of internal wave and drillship data it is concluded that internal waves may have an impact on drillship operations, and knowledge of their forces on offshore structures will be required to design production facilities in some deep water areas of the world.

57412 Response of articulated towers to waves and current. Kirk, C.L.; Jain, R.K. (Cranfield Inst. of Tech., Bedford, Eng.). pp 545-552 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The dynamic response of articulated towers to non-collinear Airey waves and steady current has been investigated, where the wave and current forces have been computed by Morison's equation. The two equations of motion obtained by Lagrange's method describe the response in terms of meridional and circumferential angles. These equations are highly non-linear and are solved numerically by the block integration method for various wave parameters. The predicted response is a complex whirling motion of the tower about a vertical axis.

57413 Inspection and monitoring of concrete structures for steel corrosion. Browne, R.D.; Domone, P.L.; Geoghegan, M.P. pp 571-580 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The problem of inspection of concrete structures has been studied, particularly in relation to the detection of corrosion of steel embedded within, or attached to, the structures. The paper describes the possible corrosion processes involved and inspection techniques for offshore use. At present only visual surveillance is being considered for the statutory surveys to be carried out in the North Sea, no suitable alternatives being readily available. Development of techniques based on concrete sampling, electrolytic inspection methods, and other non-destructive tests, are discussed in the paper, as well as possible problems in their use. The value of installing permanent corrosion detection devices at the construction stage is also considered since any in-service corrosion, particularly, for example, in the prestressed cables, might ultimately affect the safety of the structure. It may be simpler to monitor rather than undertake underwater inspection of even selected critical regions of the large surface areas involved.

57414 Electrical resistivity of concrete in the oceans. Gjoerv, O.E. (Univ. of Trondheim, Norway); Vennesland, O.; El-Busaidy, A.H.S. pp 581-588 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The electrical resistivity of concrete is one of the main controlling factors in connection with corrosion of embedded steel. Reliable information about the electrical resistivity is also very important for evaluation of galvanic couplings between freely exposed steel and embedded steel and for design and efficiency of cathodic protection of the freely exposed steel in such galvanic couplings. A number of experiments were undertaken in order to provide data and information on the electrical resistivity of concrete in general and for concrete exposed to ocean environments in particular. By successively drying out the concrete from 100- to 20-percent water saturation, the electrical resistivity increased from about 7×10^3 ohm cm to about $6{,}000 \times 10^3$ ohm cm, indicating that the degree of water saturation is the main controlling factor for the electrical resistivity of concrete. The results also indicate that those factors controlling the permeability of the concrete also affect the electrical resistivity. Thus, by reducing the water-cement ratio from 0.70 to 0.50, the resistivity of mortar was more than doubled, and for a water-cement ratio of 0.50, the resistivity of mortar was more than three times higher than that of concrete. Cracking of the concrete due to drying shrinkage did also affect the resistivity significantly. Contamination of concrete with chlorides in amounts of up to about 1-percent $CaCl_2$ based on the cement weight, slightly increased the resistivity, while larger amounts of up to about 8-percent $CaCl_2$ reduced the resistivity with up to about 50 percent. Chemical action between concrete and sea water formed a dense layer on the concrete surface, which increased the electrical resistance distinctly. Hence, this is also an effect that must be taken into account for concrete structures exposed to ocean environments.

57415 Strength of new composite steel—concrete material for offshore structure. Matsuishi, M. (Hitachi Shipbuilding and Engineering Co., Ltd., Osaka); Nishimaki, K.; Takeshita, H.; Iwata, S.; Suhara, T. pp 589-594 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A new composite steel-concrete material was developed for the strength members of huge offshore structures, in which concrete is placed between steel plates. The results of both experimental and theoretical investigations into the strength of the new composite material are presented. Experiments under static and repeated loadings were carried out. Four types of test models of the composite material were subjected to shear, bending or combined shear and bending. It was found that the ultimate strength of the composite material is very high and it can absorb a great deal of energy at failure. A method for the ultimate strength analysis of the composite material is developed. The calculated results are in good agreement with experimental ones. Nonlinear analysis is carried out using the finite element method. In the analysis, the material nonlinearities of both concrete and steel are fully taken into account; the propagation of a crack in concrete caused by tension, plastification and crush of concrete by compression, and plastification of steel plate. Geometrical nonlinearity caused by gaps between concrete and steel is also considered. The analysis accurately represented the behavior of the composite material under tests. The new composite material is found to be desirable for the construction of offshore structures because of their excellent properties; large energy absorption, and strength carrying capacity.

57416 Review of long-term exposure of aluminum in marine environments. Snodgrass, J.S.; Caruthers, W.H. Jr. (Reynolds Metals Co., Las Vegas, NV). pp 595-602 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The history and properties of aluminum alloys of particular interest to the marine and offshore industries are discussed. Four case histories of long-term marine applications are discussed. These include drill pipe, instrument platforms; Lake Maracaibo oil production facilities, and well guards in the Gulf of Mexico area. Comparisons are made between the performance of steel and aluminum in comparable applications. Corrosion problems and their solutions in these marine applications of aluminum are discussed.

57417 NAREF buoy, a deep-sea navigation aid. Sender, F.K. pp 39-48 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

NAREF is a concept of a buoy design for navigation reference to be moored preferably in deep-sea areas to back up positioning of survey-vessels, where landbased radionavigation aids do not yield sufficient accuracy. The buoy is carrier of additional radionavigation systems to allow a considerable improvement in accuracy of positioning to the survey vessel. The layout of the NAREF concept is to grant a considerable circle of movement of the buoy about the anchoring point and therefore it requires a relatively simple mooring system. Two versions are proposed to overcome the problem of diluting accuracy of positioning due to movement of the buoy. One applies to the implementation of the system in areas with relatively constant wind and current conditions, like the trade wind zones. Here the position of the buoy is traced by mutually surveying it's position and drift rate during satellite fixes by the ship and back up the position of the vessel by data received from the buoy between satellite fixes. Another approach, which desires additional hardware expense, will permanently trace the deviation of the buoy's position to the anchoring point by an acoustical position system. This system will give a real-time information of the buoy's movement improving the overall accuracy and breaking up the environmental limitation of steady wind and current conditions. The NAREF-concept shall be a back up for integrated navigation systems employing Satellite-Sonar-Doppler and groundbased navaids, as they are state of the art, which normally do not yield the desired accuracy for certain survey missions in deep waters and far off landbased radio-navaids.

57418 Sensor-independent integration: back to basics in navigation system design. Spradley, H.; Wasilew, D.; Chappell, P. pp 49-52 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Integrated navigation systems have evolved in response to the increasing requirements for more accurate navigation of marine survey vessels. Some systems have been better than others in terms of choice of devices for combination, or in mathematical handling of data from the respective sensors, but all have been inflexible in terms of interchange of sensor types or adaptation of new devices. The basic philosophy of navigation system design is examined with primary consideration given to system objectives and control structure. The result is a sensor-independent approach to integrated navigation system design.

57419 Acoustic navigation system for site survey and geodetic positioning. Sharpe, R.T.; Galyean, P.G. pp 53-60 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

An integrated navigation system which combines data from the Transit satellite system, a network of underwater acoustic transponders and an assortment of secondary sensors is described. Particular emphasis is placed on the techniques developed for relative and geodetic calibration of the acoustic grid. The system is scheduled for deployment in Spring 1977 for survey operations in the North Sea.

57420 Underwater survey using an inertial navigation system. Stankoff, A.; Tait, R.A.R. pp 61-68 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Recent trials of an Inertial Navigation System onboard a manned submersible have proved that underwater distances over several hundred meters can be measured with an accuracy of about +- 15 cm. The system is completely self-contained, independent of transponders or beacons and free of underwater environment disturbances. It permits, in addition, to navigate over very long distances with accuracies comparable to those obtained with long or short base acoustic systems. This means that a new tool is now available to the offshore industry to simplify and/or improve the efficiency and the accuracy of underwater jobs such as tie-ins, measurement of flow-line position and length, pipe-line surveys, installation of platforms, sea bottom profiling, navigation in acoustically disturbed environment, etc.

57421 Computer simulation of single point moorings. Muga, B.J.; Freeman, M.A. (Duke Univ., Durham, NC). pp 185-196 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The behavior of a vessel moored to a single point has been studied analytically using the impulse response functions and constant inertia coefficients in a time domain formulation of the governing equations of motion. The excitations are cosidered to be due to wind and/or current from any direction. The output consists of time histories of vessel displacement (surge, sway and yaw) and hawser line loads. The results have been compared with reduced scale model studies. The work differs from previous works on the subject in several important aspects. First, the results are presented in terms of the actual time histories rather than frequency graphs. Second, the solutions of the equations of motion are obtained using both a moving coordinate system (i.e., fixed in the vessel) and an inertial system (fixed in space). Thus, no assumptions regarding small displacements and/or motions are required. Third, the influences of the previous histories of motion of the vessel are taken into account via the impulse response functions. The results of this work have direct application to the analysis and design of single point mooring systems. Mooring system requirements for differing environmental conditions and specific vessels (whose characteristics are known) can be evaluated over a wide range of circumstances given the predicted time histories of line loads and vessel motions. The results of reduced scale model tests (which are very expensive) can be greatly extended by use of the technique reported.

57422 Analysis of three-dimensional pile groups with non-linear soil response and pile—soil—pile interaction. O'Neill, M.W. (Univ. of Houston, TX); Ghazzaly, O.I.; Ha, H.B. pp 245-256 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Present methods of pile group analysis are either limited to special geometric cases or do not consider pile-soil-pile interaction. An analytical procedure is described wherein arbitrary piling geometry can be assigned, nonlinear soil response in axial, lateral, and torsional modes can be considered, and pile-soil-pile interaction can be introduced. The application of this procedure is illustrated in three example analyses, and design implications of the results are outlined.

57423 New offshore pile aligning system. Boyadjieff, G.; House, H.; Roussel, H. pp 257-266 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In offshore construction work related to platforms, one of the difficult operations has been the connection of add-on sections to pin piles as they are driven into the sea floor. The reason for this difficulty has been the relative motion of the derrick barge and the fixed platform. This paper describes the design of and the application of a pile aligning system that makes this operation much easier to accomplish. It emphasizes the design of the system and its field operation conducted in the Gulf of Mexico. It describes the design concepts, the actual hardware used to implement these concepts, and the successful operation of this hardware on the actual job site.

57424 North Sea pile driving experience with a hydraulic hammer. Jansz, J.W. pp 267-274 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Field operational results and experiences on a piledriving project in the North Sea during summer 1976 are presented. Two HBM-3000 type HYDROBLOK offshore hammers have driven the 60-in. OD skirtpiles in the 12,000 ton steel jacket of Occidental's Claymore field production platform. High number of blows-per-minute and high impact efficiency of each blow have resulted in unusually short driving times. Ease of handling due to new constructional items is described, such as the pile sleeve and the flat bottom anvil that does not contain cushion blocks. Apart from being thoroughly tested during larger periods of time on a vertical test-pile, it is the real driving of 19 batter piles down into the bottom of the North Sea in a real offshore operation that gives evidence of the reliability of this modern type of hammer. Remote controllability of all hammer functions has been exercised, being of great importance with the view on further near future applications. The Claymore field piledriving took place from above water with the aid of followers. This year the same type of hammer is going to be applied in a fully operational application in more than 1000 ft waterdepth.

57425 Reliability of laterally loaded pile analysis. Legian, M.K.; Hadley, P.K. (Northeastern Univ., Boston). pp 275-280 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A procedure is described for estimating the uncertainties in the computed deflections and bending moments in a pile subjected to lateral loads. In this procedure, the uncertainties in the soil properties and soil response are first estimated; then, employing the finite difference equations governing the pile behavior, estimates are made of the uncertainties in the computed curves which describe the

lateral behavior of the pile. Several example studies are presented in which a thirty-inch diameter pile embedded in clay is analyzed to obtain the uncertainties in the computed pile behavior as a function of the uncertainties in the input parameters. The results show that the accuracy of the solutions to the problem of a laterally loaded deep foundation obtained using the finite difference technique is very much dependent upon the accuracy of the predicted average soil properties and soil response. Of all the sources of uncertainties studied in this paper, the uncertainties in the undrained strength of the clay and in the ultimate resistance coefficient, which together define the ultimate lateral soil resistance, contribute most significantly to the uncertainties in the computed pile deflections and bending moments.

57426 Analysis of driving of foundation piles. Foo, S.H.C. (Univ. of Texas, Austin); Matlock, H.; Meyer, P.L. pp 281-290 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A computer method has been developed to analyze the driving of foundation piles by impact and vibration, with the hammer acting at any point along the pile. A mandrel or follower may be included in the analysis. While retaining the discrete-element concept proposed by E. A. L. Smith, the method employs an implicit (Crank-Nicolson) type of numerical solution. Soil supports may be any desired nonlinear functions of pile displacement history. Degradation in ultimate soil resistance under the action of inelastic rebound and reload of the pile may also be introduced.

57427 Design and installation of the piling foundation for the Hondo platform in 850 feet of water in the Santa Barbara Channel. Cunningham, G.R.; Naughton, H.R. pp 291-298 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

As pile supported platforms approach deeper waters, pile installation takes a significantly larger share of the water phase erection time. The pile design and installation procedure described in this paper illustrates one method of installing pile foundations for deep water platforms.

57428 Acoustic emission: new inspection technique. Dunegan, H.L. pp 349-356 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

It is shown that high amplitude acoustic emission signals are present from corrosion products accumulated on crack surfaces of a steel similar to that used for offshore platforms. It is postulated that these signals, as well as those present during crack extension due to fatigue can be utilized to locate and evaluate fatigue cracks growing on an offshore platform. Critical issues for successful continuous monitoring such as signal amplitude, separating valid signals from noise and operator involvement are given. Solutions of the critical issues involve the use of (1) frequency filtering, (2) spatial filtering, (3) parametric filtering, and (4) amplitude distribution analysis. An example of a new method of data logging using a computer-interfaced acoustic emission system which gives an operator a quick survey of the relative activity of all nodes on a typical platform is presented. It is shown that acoustic emission techniques can provide practical alternatives to present methods being used for inspection of deep water offshore structures undergoing structural degradation due to fatigue crack growth.

57429 Fatigue behavior of joints in jacket constructions. Dijkstra, O.D.; Vaessen, G.H.G. pp 357-364 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The results of a literature review concerning the (corrosion) fatigue behavior of joints in jacket constructions (particularly in the North Sea) are discussed. The conclusions are that the stress concentration factor (SCF) calculated with a parameter formula gives an indication of the actual SCF; that the detrimental influence of sea water can be reduced using cathodic protection; that presently a lifetime calculation based on fracture mechanics encounters insurmountable problems; and that a cumulated damage rule better than Miner's is not yet available.

57430 Random load fatigue crack growth in T-joints. Hibberal, R.D.; Dover, W.D. (University Coll. of Science and Tech., London). pp 365-372 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Fatigue tests under random loading have been conducted on tubular steel (member dia equal to or approximately 0.5m)'T' joints under in-plane bending. The results show that the life of the joints is controlled by the rate of propagation of fatigue cracks through the thickness of the brace and chord walls. The growth of the crack has been analyzed and satisfactory life estimates made using a fracture mechanics approach.

57431 Behavior analysis and crack initiation prediction of tubular T-connections. Yoshida, K.; Inui, T.; Iida, K. (Tokyo Univ.). pp 373-380 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A program system based on the finite-element method was developed for the detailed behavior analysis of the vicinity of intersection of tubular T-connections. This program system consists of a nonlinear shell analysis program, a nodal data generation program, and a nonlinear solid analysis program. The strain distributions calculated by this program system show a good agreement with experimental results. Experimental results of fatigue crack initiation life of tubular T-connections are evaluated by applying the calculated equivalent strain amplitude into the fatigue strength curve for the same material as that of the connections and into the X-curve in AWS Code, suggesting unsatisfactory safety factor to the X-curve, especially in the lower cycle range.

57432 Corrosion fatigue crack propagation tests on steels for offshore structures. Bardal, E.; Haagensen, J. pp 381-390 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The importance of research work on fatigue of deepwater offshore structures is discussed in the context of the special operating conditions for such structures. Problems in establishing realistic conditions for fatigue tests, and the possibilities afforded by the application of fracture mechanics are indicated. The need for more research in several areas is emphasized. Experimental investigations, in which the effect on crack growth of cathodic protection and narrow band random loading were studied, are described. The experimental conditions and an unconventional test specimen containing six cracks are discussed. Some early test results are given.

57433 Investigation into the stress distribution and fatigue strength of a welded tubular T-joint. Martin, T.; McGregor, J. (National Engineering Lab., East Kilbride, Scotland). pp 391-398 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The prerequisites for fatigue analysis of tubular joints are knowledge of local stresses at critical areas and an appropriate design S/N curve. Cumulative fatigue damage can then be calculated for a given loading spectrum. An experimental investigation is described of an axially loaded small-scale T-joint to measure the maximum stress concentration and compare it with formulas from the literature, to obtain constant-amplitude fatigue data for comparison with proposed design curves and to investigate the suitability of Miner's rule from the results of variable-amplitude fatigue tests.

57434 New underwater welding process proved for continental shelf depths. Lythall, D.J.; Pinfold, B.E. pp 399-408 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A new flux-cored wire arc welding process has been developed for use in underwater welding inside ambient pressure dry welding chambers. The process offers a number of advantages over current alternatives, exhibits good arc stability and fusion characteristics, high metal deposition rates and excellent mechanical properties as long as correct chemical conditions are provided at the arc. The process has been successfully used offshore, has been approved by the major classification societies, and represents a significant advance in the field of subsea welding.

57435 Classification of dynamic positioning systems. Drager, H. pp 415-422 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Rules for the Construction and Classification of Dynamic Positioning Systems for Ships and Mobile Offshore Units is a new set of Rules released by Det norske Veritas. The Rules are aimed at

establishing a minimum level of safety and reliability for dynamic positioning systems through standardization, unification of performance description, formalized system documentation, system testing and in-service inspection. In order to cover different applications, a grouping is introduced depending on DP-system layout and the vessel's ability to operate in different environments. Highlights from the various sections of the Rules and examples of application are described.

57436 Installation of offshore platforms: reflections from a certification viewpoint. Fjeld, S.; Braathen, N.F.; Hansvold, C. pp 441-448 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Some selected problem areas related to installation of gravity concrete structures are identified and discussed. Certification involvement and criteria given in regulations are briefly dealt with. A short description of instrumentation systems is given. Planning and organization aspects are briefly mentioned.

57437 Nondestructive examination of subsea structures using acoustic emission technology. Parry, D.L. (Exxon Nuclear Co., Inc., Richland, WA). pp 467-474 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

In October of 1976, Exxon Nuclear Company, Inc. conducted the first offshore, undersea nondestructive examination using their NDT-ACOUSTICS technology. For a period of over six years, Exxon Nuclear has been applying their technology for the integrity of large industrial structures. The October test was, however, the first application of acoustic emission analysis technology in an undersea environment on an offshore platform. The technology was demonstrated to be a sensitive new tool for the fast, accurate detection and location of discontinuities in subsea structures.

57438 More reliable acoustics through spatial diversity. Roberts, J.L. pp 481-488 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Signal deterioration during heavy weather is a major problem in the use of acoustic techniques for determining the position of offshore vessels and floating platforms. Strong winds and heavy wave action during storms and wash from propellers create a near-surface layer of highly aerated water in the transmission path, resulting in excessive attenuation of the acoustic signal and poor reliability of the position-reference system. The concept of spatial diversity through the use of redundant single-hydrophone phase-comparison acoustic position-reference systems can be shown to improve acoustic system reliability by an order of magnitude over the more conventional pulse-arrival-delay systems of the past. This paper illustrates how spatial diversity techniques are implemented and predicts the reliability improvement that can be expected for various alternative configurations. The performance predictions are validated by field data recorded aboard a dynamically positioned drillship during severe weather conditions. It is demonstrated that by use of the phase-comparison method of position determination, with the enhanced spatial-diversity capability that it makes possible, an array of four hydrophones experiencing signal-loss-rates as high as 80% can produce a total acoustic system dropout rate (down time) of only 3.7%.

57439 Optimizing of the automatic positioning system of a pipe lay barge based on practical knowledge. Hoppe, D.; Wilke, K. pp 499-506 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A description is given of the experience gained using an automatic positioning system on the VIKING PIPER pipe lay barge during operation. In the beginning the capability of the system was sometimes reduced because of malfunctions and inaccuracies in parts of the measuring equipment. It later turned out that it was not possible to eliminate all sources of disturbances. The problems were, therefore, overcome by using another control equation. This allowed the operator to continue semi-automatic control of the barge, even in case of a failure of the transmitters which proved to be unreliable.

57440 Safe ventilation systems in spite of high winds. Fulton, B.; Lindberg, B. pp 515-524 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Early ventilation systems for platforms were designed without considering the high winds prevailing at sea, which could cause dangerous pressure variations to exist within the modules. Research based on studies of wind forces and wind tunnel tests has made it possible to design the ventilation system, choose the right equipment and the position of inlets and outlets, taking account of the module shapes and giving stable operating pressures and safe systems.

57441 Large displacement mooring dynamics. Nuckolls, C.E. (Florida Technological Univ., Orlando); Dominguez, R.F. pp 19-30 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Dynamic analysis procedures are presented for predicting the behavior of cable moored systems used to restrain floating or submerged structures where the excitation is such that the motions are large and the response non-linear. The mathematical models used incorporate discrete parameter representation and numerical solution methods. Both a linear and non-linear dynamic analysis procedure is demonstrated through application to a trapezoidal moor, containing a large cylindrical inclusion. Results are developed through an integrated use of static, non-linear, and linear dynamic analysis procedures which the discrete parameter representation makes possible; and a procedure discussed for determining the necessity of using a full dynamic vs. quasi-dynamic analysis when the mooring excitation is due to a slowly varying cause as results from changing ocean currents.

57442 Behavior of moored ships in waves. van Oortmerssen, G. pp 39-50 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A method is described for the mathematical simulation of the behavior of a moored ship in waves. The method is based on the equations of motion in the time domain according to Cummins, while the hydrodynamic loads on the ship are obtained by means of the three-dimensional source technique. Results of computations for a ship moored to a jetty are discussed and compared with experimental results.

57443 Stability of offshore gravity structure foundations by the upper bound method. Murff, J.D.; Miller, T.W. (Exxon Production Research Co., Houston, TX). pp 147-154 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

One of the primary design considerations for offshore gravity structures has been safety against foundation collapse. The analysis of this problem is complicated by inclined, eccentric loads, nonhomogeneous anisotropic soil strengths, and complex base geometries. These factors create difficulty in applying the standard bearing capacity formulae to estimate collapse loads. A method is presented for treating these complexities directly, avoiding the problem of determining "equivalent" simplified conditions or applying intuitive methods (e.g., limit equilibrium) that require subjective interpretation. The method utilizes the upper bound theorem of plasticity and hence is itself approximate; however, thru prudent application it does provide good agreement with available exact and empirical solutions. Of particular value is the capability to investigate relative effects such as homogeneous vs. nonhomogeneous soil conditions and geometric effects such as circular and multi-leg bases. Furthermore, the method is easy to implement. The procedure is illustrated by presenting solutions for the bearing capacity of a tripod and a circular base structure on cohesive soils subjected to inclined, eccentric loading. In addition, examples of upper bound analyses of the sliding resistance of tripod structures and shear key efficiency are presented.

57444 Hydroelastic response of flexibly-mounted cylinders in harmonic flow. Sarpkaya, T. (Naval Postgraduate School, Monterey, CA). pp 155-159 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Transverse oscillations of a flexibly-mounted rigid cylinder in harmonic flow have been investigated through the use of a U-shaped vertical water tunnel. The results have shown that the largest amplitudes of oscillation for a given damping ratio, Keulegan-Carpenter number, and the Reynolds number occur when the vortex-shedding frequency is nearly in tune with the natural frequency of the cylinder. It has also been found that the amplitude of oscillations is proportional to the square of the reduced velocity defined by U/sub m//f/sub n/D.

57445 Influence of surface roughness upon the drag of circular cylinders in waves. Matten, R.B. pp 185-192 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A laboratory investigation has been made of the effect of surface roughness on the force experienced by vertical surface piercing cylinders in waves. It was found that the wave force was increased significantly and a simple analysis using the Morison equation indicated that the drag coefficient had been increased by around 60%. It is suggested that these results are relevant to full scale structures.

57446 Forces on cylinder arrays in oscillating flow. Bushnell, M.J. (Hydraulics Research Station, Wallingford, Eng.). pp 193-198 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Laboratory tests have been carried out in a pulsating water tunnel to determine the flow interference effects between cylinders in an array subjected to harmonic oscillating flow. The modification to the drag and transverse vortex shedding force on each cylinder due to the presence of neighbouring members has been measured in the form of interference coefficients. The results show reduction of drag on shielded cylinders but a significant increase (up to three times) of the maximum transverse force on a cylinder in the wake of another, the effects increasing with the flow orbit length. The primary area of application is intended to be to the design of conductor tube arrays for offshore oil production platforms, and the results are discussed in this context.

57447 Dynamic response of a gravity platform under random wave forces. Nataraja, R.; Kirk, C.L. (Cranfield Inst. of Tech., Bedford, Eng.). pp 199-208 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A spectral analysis of a typical multi-tower gravity platform is carried out considering soil-structure interaction. The modal frequency response function and the linear hydrodynamic load transfer functions are determined taking into account diffraction effects. The displacement and wave loading spectra are evaluated for sea states described by the JONSWAP wave height spectrum relevant to the North Sea environment. Considerable simplification is achieved by a reduced interaction model together with complex notation for wave forces. A detailed parametric study using various values of soil shear modulus yields rms values of deck displacement and tower elastic deformation.

57448 Gravity platform tower vibration. Jenssen, D.N.; Hjertas, B.; Jensen, J.J. pp 209-216 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Results of vibration tests are presented on two concrete gravity structures, comprising free tower vibration in air and in submerged position and from a platform installed in the North Sea. Dynamic properties of tested structures are compared with design assumptions, and their influence on extreme loads and fatigue life is discussed. The observations indicate a conservative design.

57449 Evaluation of the dynamic behavior of offshore structures by model tests, field measurements, and theoretical analysis. Kawase, K.; Nishimura, K.; Kurata, S. pp 217-224 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

To investigate the dynamic behavior of offshore structures to irregular waves, model tests were conducted using frame and column models, and field measurements of the vibrations of an offshore structure installed in 80 m of water were made. Theoretical analyses were made of the dynamic response of offshore structures to irregular waves, and calculated values were compared with the results of model tests and actual field measurements. From these studies to evaluate the dynamic response characteristics of offshore structures to irregular waves, data necessary for the dynamic design of deep-water offshore structures were obtained.

57450 Dynamic ice—water—soil—structure interaction of offshore towers including nonlinear soil behavior. Haldar, A.K.; Swamidas, A.S.J.; Reddy, D.V.; Arockiasamy, M. (Memorial Univ. of Newfoundland, St. John's). pp 225-234 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The dynamic analysis procedures, both deterministic and stochastic, for predicting the dynamic response of offshore tower—foundation systems to ice-forces is described. Representing the hydrodynamic interaction by the added water mass concept, the foundation—structure interaction is investigated using (i) a lumped parameter (also called half space continuum and soil springs) model, and (ii) a plane strain finite element model. The nonlinear soil characteristics are treated in terms of displacement and strain dependency along the depth of the foundation. The ice force records are generated artifically from sample records. The force input is specified in three different ways: (i) Time history records, (ii) Response spectra, and (iii) Power spectral density functions. Rationalization of the existing design requirements is based on the numerical results obtained.

57451 Inelastic dynamic analysis of tubular offshore structures. Marshall, P.W.; Gates, W.E.; Anagnostopoulos, S. pp 235-246 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A computer program for inelastic dynamic analysis of tubular offshore structures has been developed. This includes a strut element which models the inelastic stretch and post-buckling behavior of braces, and a failure algorithm based on limiting ductility at plastic hinges. Application to a pile-supported example platform, subjected to extreme shaking well beyond normal elastic design limits, demonstrates survival in site of damage.

57452 Structural integrity evaluation of a fixed platform using vibration criteria. Wojnarowski, M.E.; Stiansen, S.G.; Reddy, N.E. pp 247-256 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A rational evaluation of the structural integrity of an offshore structure based on vibration calculations and on-board vibration measurements is performed for the USCG Ambrose Tower, a four-legged fixed platform at the entrance to New York Harbor. A mathematical model of the structure is analyzed by the SAP IV computer program, taking into consideration the effects of mass, entrained water, soil support conditions, equipment, etc. The various parameters affecting the lower-mode vibration characteristics of the structure are considered separately and their quantitative effect on the natural frequencies is evaluated. The theoretical analysis provides a convenient way to incorporate changes of structural, inertial and foundation properties, together with their effect on the vibratory response of the structure. Results of computer calculations are presented to illustrate this capability. Vibration measurements taken on the tower are recorded and processed through a spectrum analyzer to establish correlation between calculated and measured results. This method of structural integrity evaluation by means of vibration characteristics, applicable to many types of offshore structures, can reduce costly, inconvenient inspections and eliminate sources of unexpected catastrophic failure through early damage detection and repair.

57453 Lay trials in the Sicilian Channel in 2,000 ft. of water: engineering approach; pipe-laying experiences. Matteelli, R.; Lalli, D.; Silvestri, A. pp 257-268 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Trials were conducted to demonstrate the validity of the approach to the environmental data acquisition, processing, assessment, and engineering procedures in very deep waters. Design aspects are discussed including theoretical preparation; selection of the route through morphologically irregular areas where it is impractical or even impossible to modify the environment; study of the data acquisition system and its specific components; and procedures for selection and analysis of data gathered during the trials. Pipe laying trials were conducted to experiment and validate procedures, techniques and new solutions to operations in 2,000 ft of water including mooring the lay vessel with the accuracy and the efficiency necessary to lay; laying I6 and I2 inch pipelines, abandoning and recovering them; installing artificial supports to reduce free spans of the pipeline; and recovering a wet buckled pipeline. Exhaustive data gathered through advanced instrumentation and computerized acquisition system contribute to a better knowledge of the phenomena met during operations.

57454 Rough weather drilling vessel simulation. Shell, R.C.; Masso, A.H. pp 327-332 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Gulf of Alaska may have the roughest wave climate ever faced by the offshore oil industry. The high cost of time lost due to these rough seas was a major factor in selecting a floating drilling rig. A simulation method that was used to estimate down times of floating rigs in the Gulf of Alaska is described. The simulator has two parts: one that simulates operations and another that simulates weather interference with those operations. While the operations model drills a well, a novel weather model generates both wave heights and periods. Wave heights and periods determine vessel motions, which are checked against operating limits. If motions exceed the limits, work is slowed down or stopped. The weather model in the simulator can be applied to other offshore areas provided enough wave data exist. This approach also can be used for simulating offshore tanker loading, pipelaying or platform installations. Furthermore, the simulator can assess the value of hardware improvements that permit operations to continue in rougher seas. Statistical tests on the weather model showed that it adequately simulated Gulf of Alaska sea conditions. Furthermore, rig down time calculated with the simulator proved to be more realistic than down times calculated with models using just wave height.

57455 Design and installation of piles in chalk. Vijayvergiya, V.N.; Cheng, A.P.; Kolk, H.J. pp 459-464 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Amoco International Oil Company has installed drilling and production platforms in a hard chalk formation in Rough Field, British Sector of the North Sea. A quasi-effective stress method was used to compute pile capacity in chalk and is presented. The computed capacity is compared with soil resistance data from analyses of pile driving records. Axial pile load-movement relations are developed for use in structural analysis of the platforms. While installing the piles with Menck 1500, 2500 and 2500 SL hammers, delays ranging from a few minutes to 61 days occurred. Analyses of driving resistances before and after delay shows that soil resistance increased significantly due to delays during driving. Based on a correlation between the amount of soil set-up and the delay period, it is believed that during continuous driving, the soil resistance was about 65% of the computed static capacity and after two months delay, the most probable static capacity is at least 15% greater than the computed capacity.

57456 Design criteria for grouted piles in sand. Ehlers, C.J.; Ulrich, E.J. Jr. pp 475-482 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A design procedure is presented for predicting the frictional capacity of grouted piles in sand. The premises underlying current design practice as they apply to the frictional capacity of piles in sand are reviewed, especially the empirical and theoretical basis for limiting skin friction for driven and grouted piles in sand. In the proposed new procedure, soil-to-grout friction is predicted as a function of the grout fluid pressure, increasing hydrostatically with depth and with effective pile-soil load transfer limited only by the bond stress between the grout and pile. The changes in lateral stresses during installation and the influence of drilling mud on the development of skin friction are discussed.

57457 Construction of the Hondo platform in 850 feet of water in the Santa Barbara channel. Bardgette, J.J.; Irick, J.T. pp 7-16 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The extreme water depth over the Hondo Field in Santa Barbara Channel was the principal factor which made the construction of Exxon's Hondo platform unique. Completion of constructon on schedule made the project note-worthy. Components of the platform were fabricated in two states, California and Louisiana. Elements of the jacket were fabricated in four plants in California and transported to Oakland for assembly. The jacket was constructed in two pieces with the eight legs initially connected by flange and with four stabbing cones for marine realignment and joining. Each jacket section was separately transported and launched. Following launching, the two jacket sections were joined while floating and all eight legs were permanently connected by welding from inside of the legs in dry water tight chambers. The jacket was towed to the erection site and upended by remotely controlled flooding and set on the sea floor. The bulkheads, which compartmented the legs, were removed and the world's longest piles were driven.

57458 Design of the Hondo platform for 850-feet water depth in the Santa Barbara channel. Delflache, M.L.; Glasscock, M.S.; Hayes, D.A.; Ruez, W.J.; Wildenstein, A.W. pp 17-26 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Exxon Company, U.S.A. has recently installed a drilling and production platform in the Santa Barbara Channel off California in a water depth of 850 ft. Many of the design problems associated with this effort were especially challenging because of the water depth and seismicity of the area. Exxon solved these problems with a concentrated effort to extend Gulf of Mexico technology thus minimizing the need for new methods and equipment. A description is presented of the platform and the criteria governing its in-place design. The background of these criteria are discussed as are the analyses performed, to assure that each criterion was satisfied. Earthquake, severe storm, and operating loads were considered as well as the platform's fatigue resistance and structural ductility. The results of these analyses are discussed.

57459 Mackerel/tuna platform design and installation. Bender, C.H.; Jones, J.A.; Swanlund, C.A. Jr.; Wardell, J.B. pp 27-38 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

An improved conventional template design has been developed to minimize construction weather sensitivity and reduce offshore installation time. Major innovations include incorporating deck legs and support structures to the (+)55 ft elevation (integral jacket cap) as part of the launched template, carrying maximum amounts of piling with the template during launch, and the use of an on-template construction module to speed pile installation and reduce dependence on weather-sensitive derrick barge operations. An effective technique for installing drilled and grouted piles was developed and proven in the field. The first platform of this design was installed in the Mackerel field in 304 ft of water in the Bass Strait, Australia. A second platform, which was designed concurrently with the Mackerel platform, is currently being installed in 195 ft of water at the nearby Tuna field. Construction is in progress on Tuna. Construction savings over conventional design as a result of innovative design improvements are estimated to be about seven weeks derrick barge time per platform.

57460 Stability of gravity-type platforms by filling under the raft. Boon, C.; Gouvenot, D.; Gau, M.; Geffriaud, J.P. pp 39-44 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

An under raft grout filling method for offshore platform bases is described. The results obtained using this method of grout filling under the raft of the FRIGG TP 1 platform confirmed that the technique and the plant are of sound conception and give satisfactory results. Monitoring of the filling process allows confirmation that each skirt compartment has been properly filled. The completion of ballasting the platform, 24 hours after the end of filling the first compartment showed that the grout could be loaded soon after placement. This is due to the fact that the grout is contained in a completely closed volume. The differential ballasting used was a successful method in maintaining the platform at a much lower tilt than the sea-bed slope, and the grout filling succeeded in blocking the platform in this position.

57461 Installation of a gravity-based flare tower with bridge at 380-feet waterdepth. Ochtman, J.A.A.; Donath, C.D. pp 45-54 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The installation of the Flare Structure for the Mobil Beryl "A" Platform U.K. concession 9/13 in the North Sea during the summer of 1976 is described. The total job included preparatory operations like load-outs, towages, seafastenings and the last stages of the construction work. The on-site events together with their engineering and the selection of the methods used from various possible alternatives are emphasized. The importance of a close cooperation between client, designer, and installation contractor in an early stage is shown, resulting in a structure with installation features enabling the use of simple down-to-earth equipment. The extent and reliability of the systems and equipment together with back-up alternatives, are discussed, in relation to the controlled emplacement of the footing within tight tolerances of coordinates and orientation, and the degree of reversibility.

57462 Welded connection under atmospheric pressure for repair of large diameter pipeline. Gendreau, A.A.; Gouraud, O.M.; Fleury, G. pp 91-96 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Welding at atmospheric pressure for pipeline repair or pipeline tie-ins has the advantage of applying onshore working conditions and procedures at great depth and without modifications. To perform this connection, a new submarine system has been built and tested. Consisting of three main modules : a Welding base and Plug system, a Support Module and a Transfer Module. The results of the test program initiated in January 1976 show the system is workable to 300 m, and sufficient precision is attained for positioning pipe ends for ordinary welding procedures by using the newly developed alignment frame.

57463 First dynamically stationed semi-submersible: SEDCO 709. Hammett, D.S. pp 97-111 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Information is presented concerning the design parameters, fabrication, and sea trials of the first semi-submersible equipped for dynamic stationing for drilling exploratory wells in rough, open, deepwater environments. Design criteria are reviewed with regard to sea state, environment, propulsion requirements and drilling performance, including automatic control and sensing systems. A review of second generation subsea BOP, control and re-entry equipment is presented. Operating systems are summarized, and performance expectations are related to prospective utilization of the vessel in specific ocean areas. Preliminary conclusions are given with respect to vessel response to control and propulsion parameters.

57464 Super-sized semisubmersible performance in the North Sea. Kobus, L.C.S.; Meyers, H.M.; Haines, S.W. pp 113-126 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The super-sized 30,000 ton displacement ZAPATA UGLAND has been drilling in the North Sea since August 1974. The weather effects, the associated rig motions, and the drilling performance in North Sea operations are summarized. The design, equipment, and operational aspects of the ZAPATA UGLAND that have been key factors in its splendid performance in the North Sea are emphasized. A discussion is presented of model test data and the experienced motions and performance. It is concluded that (1) super-sized semisubmersibles, such as the ZAPATA UGLAND, are the optimum type of unit to use in year around operations in deeper waters of the North Sea and (2) self propulsion for a semisubmersible is operationally effective and reliable.

57465 Analysis of semisubmersible catamaran-type platforms. Paulling, J.R. (Univ. of California, Berkeley); Hong, Y.S.; Chen, H.H.; Stiansen, S.G. pp 135-144 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The development of a computational system for determining the wave-induced loads and motions of semisubmersible catamarans is described. The procedure is based upon a strip theory computation of the hydrodynamic forces and utilizes a modified Frank close-fit technique for obtaining sectional added mass and damping coefficients. By this procedure the flow interaction effects between the two hulls and the effects of the free surface are taken into consideration. A number of pilot studies have been undertaken to ascertain the importance and nature of these effects. Example calculations for configurations having the proportions and other features typical of real semisubmersibles have shown that the hydrodynamic forces on the vertical surface-piercing legs play an important role in determining platform motion response. The forces on these legs may be approximated by including the legs in the stripwise representation of the main hulls, or the legs may be treated separately. Neither method yields completely satisfactory predictions of the platform response in the case of legs of large cross section. For slender legs and deeply submerged hulls, however, the predicted motions are in good agreement with model test results.

57466 Deep water drilling from a moored semisubmersible. Kobus, L.C.S.; Meyers, H.M.; Bounds, V.G. pp 165-174 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A new series of floating drilling semisubmersibles, the Zapata SS-2000 class, have been in operation for a total of 24 months. During that time, the first two rigs of the four rig series have drilled at twelve locations in the 900 to 1400 feet water depth range in the Gulf of Mexico. Descriptions are presented of the design features of these innovative semisubmersibles and their unique deep water mooring systems. Operational techniques and problems peculiar to drilling in 1000 feet of water are discussed. Operating experience is described that can be of use in advancing normal floating drilling operational capabilities into deep water.

57467 New generation submersible with dry transfer into one-atmosphere chamber capacity. McDonald, R.D. pp 175-180 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

General acceptance of submersibles as useful industry tools has led to the development of the New Generation Submersible (NGS). One such NGS is described. It has all the inspection and manipulator abilities of earlier vessels with the added capability of diver-lockout, transfer under pressure and dry transfer into one-atmosphere subsea chambers. The NGS measures 34 ft. length, 13 ft. beam, 12 ft. height and weighs 53,000 lbs. Payload is in excess of 2 tons and depth rating is to 1100 ft. This submersible was launched on 7 February 1977 and after sea trials is planned to be exhibited at the OTC before entering service in the Gulf of Mexico.

57468 Concrete offshore structures: behavior of full scale shells, hydrostatically loaded. Gausel, E.; Hafskjold, P.S. pp 323-328 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Findings from a pilot study of the strain development in the first Condeep concrete platform, Mobil Beryl A, installed in the North Sea in 1975, were presented at OTC-75, Paper 2405, and OTC-76, Paper 2435. The Cement and Concrete Research Institute of the Norwegian Institute of Technology has continued and intensified these investigations on the third Condeep platform, Statfjord A. which is to be installed this summer (1977). The objective of the research program is to study the strain development and the relationship between the strains and the external loads. The conclusions drawn should also be valid for hydrostatically loaded shells in general and not only to this particular type of concrete platforms.

57469 Single anchor leg mooring system for the North Sea. Foolen, J.; Pincemin, M.; Smulders, L. pp 557-564 of Ninth annual offshore technology conference. Proceedings. Volume IV. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The design of a riser-sparbuoy SALM for 533 feet water depth, to be installed at the Thistle Field in the North Sea is described. The terminal will serve 80,000 DWT tankers in wave heights of 15' significant. Survival conditions are 100 foot waves and 100 knot winds. The theoretical background, as well as construction of this SALM is discussed. Adaptation of the basic SALM design for use in the deep waters of the Northern North Sea has been achieved. Key to this proved to be a proper tuning of all system oscillations. By doing so a SALM resulted which behaves remarkably quietly in both operational and survival conditions. This will increase the lifetime of hawsers, hoses and mechanical components. A second improvement is the placing of the fluid swivels inside the buoy. This allows for easy swivel maintenance and replacement as well as pollution control.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 57528

57470 (PB—276645) **Use of electrostatically charged fog for control of fugitive dust emissions. Final report December 1976—October 1977.** Hoenig, S.A. (Arizona Univ., Tucson (USA). Dept. of Electrical Engineering). Nov 1977. 95p. NTIS PC A05/MF A01.

Results are given of tests of the use of electrostatically charged fog to control a wide variety of industrial pollutants, ranging from silica flour to SO_2 and fly ash. It has been demonstrated that most industrial pollutants acquire an electrostatic charge as they are dispersed into the air. If this charged airborne material is exposed to an oppositely charged water fog there is enhanced contact between the particulates and the fog droplets. After contact is made, the wetted particulates agglomerate rapidly and fall out of the atmosphere. The tests showed that, in general, there has been significant suppression with a minimum of water fog. The technique

is therefore well suited to control of moving or fugitive dust sources where the usual hooding and control systems cannot be applied.

57471 (UCRL—80789) **In-duct countermeasures for reducing fire-generated-smoke-aerosol exposure to HEPA filters.** Alvares, N.J.; Beason, D.G.; Ford, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jul 1978. Contract W-7405-ENG-48. 13p. (CONF-780819—19). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

An experimental program was conducted to assess the endurance and lifetime of HEPA filters exposed to fire-generated aerosols, and to reduce the aerosol exposure by installing engineering countermeasures in the duct between the fire source and HEPA filters. Large cribs of wood and other potential fuels of interest were "forcefully burned" in a partially ventilated enclosure. In a "forceful burn" the crib of fuel is continuously exposed to an energetic premixed methane flame during the entire experimental period. This tactic serves two purposes: it optimizes the production of smoke rich in unburned pyrolyzates which provides severe exposure to the filters, and it facilitates the ignition and enhances the combustion of cribs formed with synthetic polymers. The experiments were conducted in an enclosure specifically designed and instrumented for fire tests. The test cell has a volume of 100 m^3 and includes instrumentation to measure the internal temperature distribution, pressure, thermal radiation field, flow fields, gas concentration, particulate size distribution and mass, fuel weight loss, inlet and exit air velocities, and smoke optical density. The countermeasure techniques include the use of passively operated sprinkler systems in the fire test cell, of fine and dense water scrubbing sprays, and of rolling prefiltration systems in the exit duct of the fire test cell. Of the countermeasures surveyed, the rolling prefilter system showed the most promise. This paper concentrates on the effect of control variables; i.e., enclosure air supply, fuel composition and crib porosity on the combustion response; i.e., crib burning rate, enclosure temperature rise, oxygen consumption, and CO, CO_2 and total hydrocarbon production. A discussion of the attempts to rationalize smoke aerosol properties will be included along with results from the effect of countermeasure application on HEPA filter lifetimes.

57472 **Scrubber tower.** Carnicle, F.E. US Patent 4,095,964. 20 Jun 1978. Filed date 28 Sep 1976. 4p.

An improved scrubber tower is provided for removing pollutants from hot, corrosive off-gases from chemical processes, such as processes for the production of titanium dioxide pigments. The tower is formed from wood strip baffles treated with fire resistant chemicals arranged in alternate layers extending perpendicularly to each other and secured with titanium fasteners and enclosed in fiber glass walls, the flow passages through the tower being of large cross sectional area relative to the cubic feet of off-gas scrubbed per unit of time as to maintain a relatively low off-gas velocity upwardly through the tower, substantially the same as the velocity that would be present under natural draft conditions, and at low pressures, only slightly above ambient air pressure.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 57502

57473 (UCRL—80811) **Pulsed ferrite core tests for 50-ns linear induction accelerator.** Reginato, L.; Cook, E.; Dexter, W.; Schmidt, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1978. Contract W-7405-ENG-48. 4p. (CONF-7805107—1). Dep. NTIS, PC A02/MF A01.

From International magnetics conference; Florence, Italy (9 May 1978).

The Lawrence Livermore Laboratory undertook an investigation of the properties of ferrite materials to be used in a 5-MeV, 50-ns linear induction accelerator. The investigation, on a part-time basis, lasted about one year and had the cooperation and helpful suggestions of several manufacturers: TDK of Japan, Phillips of Holland, and Stackpole of the U.S.A. Ferrites have been widely used as tuning cavities for proton synchrotron accelerators at radio frequencies. In such an application, the μQf factor is used in describing the figure of merit for ferrites where a high duty factor requires low loss ferrites. In a linear induction accelerator with an average reprate of 5-Hz, the ferrite losses are negligible and the concept of complex permeability in describing the losses will not be introduced, but a large signal $\Delta B/\Delta H$ will be used to describe their properties. The properties of interest in designing the accelerating cavity were (1) flux swing ΔB = B/sub r/ + B/sub m/ greater than 0.5T; (2) a residual flux density B/sub r/ greater than or = to 0.15T with a reset no greater than 2 Oer; (3) a relatively high incremental μ greater than 400 to keep the excitation current small in relation to the load current; and (4) a high resistivity for the 250-kV voltage hold-off.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

57474 (AD-A—051303) **Studies of ion beam generation efficiency with reflex tetrodes. Interim report.** Mahaffey, R.A.; Pasour, J.A.; Golden, J.; Kapetanakos, C.A. (Naval Research Lab., Washington, DC (USA)). Jan 1978. 15p. (NRL-MR—3694). NTIS PC A02/MF A01.

The unidirectionality of the ion current in a reflex tetrode has as a result the efficient generation of pulsed, ion beams. Experimental results are reported on the dependence of the ion generation efficiency, in a reflex tetrode, upon the applied voltage, total current, anode-anode and anode-cathode separations and applied magnetic field.

57475 **Effect of space charge on the particle dynamics in a linear accelerator with variable-phase focusing.** Baev, V.K.; Kolyaskin, A.D.; Rozanov, N.E. (Moscow Engineering Physics Institute). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 2, 96-97(Feb 1978).

Computer simulation is employed to study the effect of space charge on the effectiveness of the focusing system of a proton linear accelerator.

AUXILIARIES AND COMPONENTS

57476 (AD-A—051420) **Studies of periodic waveguide structures for generation and parametric interaction of coherent optical waves. Final report, 1 March 1973—30 June 1977.** Wang, S. (California Univ., Berkeley (USA). Electronics Research Lab.). 30 Jun 1977. Contracts N00014-75-C-0420;N00014-69-A-0200-1063. 8p. NTIS PC A02/MF A01.

The report summarizes contributions in the realization of the DBR laser for integrated optics and in the achievement of 'kink-free' injection lasers.

EXPERIMENTAL FACILITIES AND EQUIPMENT

57477 (BNL-NCS—50681, pp 7-14) **Intense high energy neutron sources and their characteristics.** Bowman, C.D. (National Bureau of Standards, Washington, DC). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The members of this workshop felt that a primary goal was to plan the measurement system by which detailed neutron intensities and energy distributions could be specified in whatever irradiation facility might be used for damage studies. Among the aspects considered were the following: d-T and t-D source characterizations, d-Li source characterizations, other reactions, detection sandwich testing, and calculational approach. Both the activation package and the calculational method appeared feasible as means to establish completely the characterization of any field suitable for damage irradiations. Each approach has its merits and its problems. It was recommended that the required measurements and calculations be given the same priority as the detailed accelerator design to assure that the facility is planned for maximum usefulness and to assure that the tools for damage studies are at hand as soon as the facility becomes operational. Seven specific recommendations were made. (RWR)

57478 (BNL-NCS—50681, pp 247-255) **Facility for neutron-induced charged particle reactions in the energy range E/sub n/ = 20 to 60 MeV.** Romero, J.L.; Subramanian, T.S.; Brady, F.P.; King, N.S.P.; Harrison, J.F. (Univ. of California, Davis). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Variable-energy, nearly monoenergetic neutron beams are produced from proton beams from the sector focusing isochronous cyclotron at Crocker Nuclear Laboratory. The simultaneous measurement of the continuum spectra of charge-1 and -2 particles is accomplished by using three-element telescopes incorporating fast timing in each detector. Energy and time parameters from the detectors and fast logic are interfaced to a PDP 15/40 computer via CAMAC. On-line and off-line data processing is performed on each type of particle. As an illustration, results are presented for the 4- to 30-MeV alpha spectrum produced by 40-MeV neutrons on carbon. 4 figures, 1 table.

57479 Startup of the URAL-15 linear proton accelerator with quadrupole rf focusing. Gorshkov, B.M.; Il'evskii, S.A.; Kolomenskii, G.M.; Kuznetsov, S.P.; Kutorga, N.N.; Mal'tsev, A.P.; Mal'tsev, I.G.; Mirzoev, K.G.; Stepanov, V.B.; Teplyakov, V.A.; Shalashov, I.M. (Institute of High-Energy Physics, Protvino). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 11, 1348-1349(Nov 1977).

The URAL-15 accelerator is the first stage of a 30 MeV linear accelerator (the URAL-30), intended for use as an injector into the booster of the proton synchrotron of the Institute of High-Energy Physics. The basic parameters of the accelerator and the results of the first startup and adjustment experiments are reported. Accelerated protons with an energy of 15.9 MeV have been obtained. The maximum accelerated current is greater than 50 mA. The spectral width of the pulses is 1.2%. The normalized emittance is less than 0.3 mradxcm.

57480 RF adjustment of the accelerating system of the URAL-15 linear accelerator. Golubkov, V.P.; Klokov, V.V.; Sevost'yanov, V.S.; Stepanov, V.B.; Teplyakov, V.A. (Institute of High-Energy Physics, Protvino). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 11, 1350-1352(Nov 1977).

The design of the basic parts of the accelerating system is described. The experimental procedure for studying the IE-cavity system is described. The distribution of the maximum amplitude of the accelerating field over the gaps of the accelerating system is reported. A nominal field of 160 kV/cm, (averaged over the gap) is achieved. Breakdown occurs at 200 kV/cm.

57481 Cryogenic targets within streamer chambers and supply of cryogenic fluids to targets. Golovanov, L.B. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 473-487(Sep 1977).

This review discusses the operation of cryogenic targets inside streamer chambers. Various means of supplying the cryogenic fluids to the target are discussed, and their advantages and disadvantages are given.

STORAGE RINGS

57482 (LBL—7258) **Experimental study of gas-cooled current leads for superconducting magnets.** Warren, R.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 20p. (CONF-780718—3). Dep. NTIS, PC A02/MF A01.

From 7. cryogenic engineering conference; South Kensington, London, UK (4 Jul 1978).

Design details and experimental test results from several design variations of the gas-cooled, copper current leads used in conjunction with the superconducting dipole magnets for ESCAR (Experimental Superconducting Accelerator Ring) are reported. Thermal acoustic oscillations, which were experienced with an initial design, were eliminated in subsequent designs by a reduction of the hydraulic diameter. The occurrence of these oscillations is in general agreement with the stability analysis of Rott but the observed gas flow dependence is not in agreement with some other recently reported results for leads operated supercritical phase coolant. An empirically determined correlation was obtained by plotting lead resistance vs. enthalpy gain of the coolant gas. The resulting family of curves can be reduced to a single line on a plot of effective resistivity vs. the product of current and cross-sectional area divided by the product of the square of the mass flow of the coolant and the lead length. This correlation, which should be applicable to other designs of copper current leads in which ideal heat transfer to the coolant gas is approached, predicts that the enthalpy gain of the coolant, and therefore the peak lead temperature, is proportional to the cube of the ratio of current to coolant mass flow. The effective value of the strongly temperature-dependent kinematic viscosity of the coolant gas was found to vary linearly with the effective resistivity of the lead.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 56652, 56654, 56662, 57030

57483 (ECN—37) **Nuclear data guide for reactor neutron metrology (edition 1977).** Zijp, W.L. (Stichting Energieonderzoek Centrum Nederland, Petten). Feb 1978. 72p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Numerical data on activation detector materials, on detection reactions involved, and on radionuclides produced are listed. The data are mainly taken from existing evaluations. Where evaluations were missing, unknown or obsolete data were taken from recent literature. The detection reactions considered were selected on the basis of available information of its use for reactor neutron measurements. To the opinion of the Euratom Working Group on Reactor Dosimetry, this document may contribute to the creation of a common data set for all laboratories working in the field of reactor neutron metrology. It is expected that after one or two years an updated and revised guide will be issued.

57484 (LA-UR—78-1555) **Evaluation of a radioactive aerosol surveillance system.** Scripsick, R.C.; Stafford, R.G.; Beckman, R.J.; Tillery, M.I.; Romero, P.O. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 16p. (CONF-780612—7). Dep. NTIS, PC A02/MF A01.

From Symposium on advances in radiation protection monitoring; Stockholm, Sweden (26 Jun 1978).

Measurements of the dilution of air contaminants between worker breathing zone and area air samplers were made by releasing a test aerosol in a workroom equipped with an aerosol surveillance system. The data were used to evaluate performance, and suggest improvements in design of the workroom's alarming air monitor system. It was found that a breathing zone concentration of 960 times the maximum permissible concentration in air (MPC/sub a/) for a half-hour was required to trigger alarms of the existing monitoring system under some release conditions. Alternative air monitor placement, suggested from dilution measurements, would reduce this average triggering concentration to 354 MPC/sub a/. Deployment of additional air monitors could further reduce the average triggering concentration to 241 MPC/sub a/. The relation between number of monitors and triggering concentration was studied. No significant decrease in average triggering concentration was noted for arrays containing greater than five monitors.

57485 Scintillator for gamma ray camera. Takami, K.; Ueda, K.; Kawaguchi, F.; Tomura, T.; Ishimatsu, K. (to Hitachi Medical Corp.). US Patent 4,090,081. 16 May 1978. Priority date 28 Jul 1975, Japan. 8p.

A scintillator for a gamma ray camera includes a pair of crystals mechanically pressed together. The surfaces of the crystals are roughened so as to form a photo-diffuser for the light generated as a result of scintillation.

57486 Compton scatter in germanium and its effect on imaging with gamma-ray position-sensitive detectors. Sherman, I.S.; Strauss, M.G.; Brenner, R. (Argonne National Lab., IL). *IEEE Trans. Nucl. Sci.;* **NS-25**: No. 1, 665-675(Feb 1978).

The spatial spread due to Compton scatter in Ge was measured to study the reduction in image contrast and signal-to-noise ratio (S/N) resulting from erroneous readout in Ge position-sensitive detectors. The step response revealing this spread was obtained by scanning with a 122 keV γ-ray beam across a boundary of two sectors of a slotted coaxial Ge(Li) detector that is 40 mm diameter by 22 mm long. The derived line-spread function at 140 keV (/sup 99m/Tc) exhibits much shorter but thicker tails than those due to scatter in tissue as observed with a NaI detector through 5.5 cm of scattering material. Convolutions of rectangular profiles of voids with the Ge(Li) line-spread function show marked deterioration in contrast for voids less than 10 mm across, which in turn results in even greater deterioration of the S/N. As a result, the contrast for voids in Ge images is only 20 to 30% higher than that in NaI and the S/N is only comparable for equal detector areas. The degradation in image contrast due to scatter in Ge detectors can be greatly reduced by either using thin detectors (approximately 5 mm), where scatter virtually does not exist, or by using thicker detectors and rejecting scatter electronically. To reduce the effects of scatter on the S/N as well as on contrast, the erroneous position readouts must actually be corrected. A more realizable approach to achieving the ultimate potential of Ge detectors may be a scanning array of discrete detectors (not position sensitive) in which readout is not affected by scatter.

57487 Gamma camera with reflectivity mask. Stout, K.J. (to Raytheon Co.). US Patent 4,058,727. 15 Nov 1977. Filed date 28 Jun 1976. 8p.

A gamma camera is described with a plurality of photodetectors arranged for locating flashes of light produced by a scintillator in response to incident radiation. Masking material is arranged in a radially symmetric pattern on the front face of the scintillator about the axis of each photodetector to reduce the amount of internal reflection of optical photons induced by gamma ray photons.

57488 Gamma camera. Reiss, K.H.; Kotschak, O.; Conrad, B. (to Siemens AG). US Patent 4,058,721. 15 Nov 1977. Priority date 19 Feb 1975, German, Federal Republic of (F.R. Germany). 6p.

A gamma camera within a signal generating system is described encompassing a stage converting an image which is to be photographed into an electron image, following which there is a locating or position-finding system from which signals emanate which facilitate the pictorial reproduction of the incident radiation.

57489 Correction of data loss in gamm ray scintillation cameras. Nickles, R.J. (to Wisconsin Alumni Research Foundation). US Patent 4,058,728. 15 Nov 1977. Filed date 27 May 1976. 14p.

A method of and circuitry for correcting gamma ray camera data signals for signal processing circuitry is disclosed. Pulses are artificially generated which replicate the data signals produced at the output of photo-multiplier tubes of the gamma ray scintillation camera and are inserted in the gamma ray camera internal processing circuitry in such a manner as to remain distinguishable from the data signals generated by the photo-multiplier tubes. By monitoring the number of artificial pulses produced artificially and the number of such pulses actually counted by the data processing circuitry of the gamma scintillation camera, a factor indicative of the losses of scintillation count in the processing circuitry may be determined.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

57490 (BNL-NCS—50681, pp 297-304) **Development of a spectrometer for the measurement of (n,xp), (n,xd), and (n,xα) cross sections, angular distributions, and spectra at E/sub n/ = 15 MeV.** Grimes, S.M. (Lawrence Livermore Lab., CA); Haight, R.C.; Anderson, J.D.; Alvar, K.R.; Borchers, R.R. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

A spectrometer to measure neutron-induced charged-particle-producing reactions was developed and yields data with greatly improved signal-to-background ratios. It consists of a magnetic quadrupole lens which focuses the charged particles onto a silicon surface-barrier detector or a two-detector telescope which is more than 2 meters from the sample being irradiated. The efficiency of the spectrometer is calibrated experimentally and depends only on values for the (n,p) elastic cross section and the stopping power of polyethylene. Further development is under way to replace the surface-barrier ΔE counter with a proportional counter of larger area. This detector, combined with a larger E counter (surface-barrier) could increase the effective solid angle by a factor of five. The results for (n,xp), (n,xd) and (n,xα) cross sections are summarized for the eight target materials studied so far. Measurements of the charged-particle spectra established that cross sections for production of protons below 2.5 MeV are significant for some targets; in fact, protons as low as 800 keV were detected from aluminum. These low-energy protons would be quite difficult to measure with conventional counter telescope spectrometers. 4 figures, 1 table.

HIGH ENERGY PHYSICS INSTRUMENTATION

57491 Ultrasonic bubble chambers. Akulichev, V.A.; Zhukov, V.A.; Tkachev, L.G. (Acoustics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 3, 238-258(May 1977).

The results of theoretical and experimental investigations of the problem of making ultrasonic bubble chambers (USBCs) are reviewed. The main facts and results so far accumulated are presented.

57492 Filmless chambers in high energy physics. Zanevskii, Y.V. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 3, 259-287(May 1977).

The present state of the use of filmless chambers is briefly reviewed. The basic properties of filmless spark, proportional, and drift chambers are considered, together with their application in high energy physics. It is pointed out that these detectors designed for experimental high energy physics can be used in applied investigations.

RADIOMETRIC INSTRUMENTS

57493 Ion scattering spectrometer with two analyzers preferably in tandem. McKinney, J.T.; Goff, R.F. (to Minnesota Mining and Manufacturing Co.). US Patent 4,058,724. 15 Nov 1977. Filed date 27 Jun 1975. 10p.

Improved apparatus and method for measuring ions scattered from a surface to thereby determine the mass of atoms at the surface are described. The apparatus includes two analyzers, preferably an energy analyzer and mass analyzer positioned in tandem. The mass analyzer may be tuned to pass only ions having the same mass as ions in an incident ion beam, and to reject sputtered ions, some of which may have the requisite energy to pass through the energy analyzer under a given set of conditions.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

57494 (AD-A—049626) **Thermal neutron damage in bipolar transistors. Final report.** Stanley, T.D. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Dec 1977. 70p. (AFWL-TR—77-168). NTIS PC A04/MF A01.

An experimental test was made of the hypothesis that the source of thermal neutron damage in bipolar PNP transistors is the result of thermal neutron captures by the Boron-10 present in the emitter region of the transistors. Transistors were specifically made using three different ratios of Boron-10 to Boron-11 as the emitter dopant material, and in four different geometries. Forty-two of these specially made transistors were exposed to thermal neutron fluences as high as approximately 5 x 10 to the 15th neutrons per square centimeter. In each case the damage observed corresponded to the fraction of Boron-10 to total boron used as the emitter dopant material, thus confirming the hypothesized damage mechanism. The dependence of the collector current, thermal neutron fluence, and emitter-base geometry on the observed gain degradation also indicated that bulk damage is responsible for thermal neutron damage in PNP transistors. Some devices were also irradiated in a fast-neutron environment. Fast neutrons were found to be approximately 100 times more effective than thermal neutrons in producing damage in the devices that use a naturally occurring ratio of Boron-10 to Boron-11 in the emitter.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 56331, 56333, 56349, 56353, 56509, 57001, 57531, 58087

57495 (BNL—24054) **New stem capable of observing single heavy atoms in frozen specimens.** Wall, J.; Hainfeld, J. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 3p. (CONF-780818—1). Dep. NTIS, PC A02/MF A01.

From Electron microscopy conference; Toronto, Canada (1 Aug 1978).

A new high resolution Scanning Transmission Electron Microscope (STEM) has been developed which is capable of observing single heavy atoms at 3 A resolution in specimens held at -100°C. Facilities have also been provided for preparation and transfer of frozen-hydrated biological specimens. The Brookhaven STEM is a U.S. National Institutes of Health Biotechnology Resource available to all qualified scientists on a time sharing basis.

57496 (CONF-780734—1) **Transmission scanning diffraction and microscopy in a TEM/STEM instrument.** Carpenter, R.W.; Zaluzec, N.J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Workshop on analytical electron microscopy; Ithaca, NY, USA (24 Jul 1978).

Initial experiments used a PMT/amplifier/CRT system for detection and display of diffracted intensity. The intensity distribution, whether in imaging or diffraction modes, was recorded from the CRT using a Polaroid camera. This arrangement was found to be inconvenient for several reasons. Perhaps the most troublesome problem was the variation of trace intensity with appreciable count rate changes over short distances on the CRT. The practical result of this variation was difficulty in defining the shape of strong Bragg maxima, especially with the amplifier adjusted for examination of weak peaks, and vice versa. Furthermore, the recorded intensity distribution was simply a photograph of the CRT trace. Another method for collecting data in a form more amenable to subsequent data reduction was desirable. The modified system is centered about a JEOL 100-C TEM/STEM instrument equipped with an OEM-supplied TSED unit and scan coils. At present the electron detector system consists of the scintillator/PMT unit normally used as the STEM detector. Various substitutes are currently being evaluated to increase the sensitivity of the detector system in order to optimize the overall system response. In order to increase the system versatility as well as provide synchronous data collection in a multichannel scaler (MCS), a 12-bit digital scan generator was designed and interfaced to the TSED scan coils. Besides its digital nature the scan generator has an independent set of controls which can be used to continuously vary the scan amplitude, position, and rotation of a line scan over any part of the TEM image or diffraction pattern. These controls eliminate the need to mechanically shift the projector or intermediate lens pole pieces to move some particular part of a long camera length diffraction pattern over the detector aperture, which was a necessary inconvenience with the former system. The variable linear amplifier adds up to two orders of magnitude amplification. (WHK)

57497 (IS—4438) **Wide range constant current power supply.** Weber, M.F. (Ames Lab., IA (USA)). Feb 1978. Contract W-7405-ENG-81. 13p. Dep. NTIS, PC A02/MF A01.

A calibrated, constant-current power supply has been constructed with a total current range of 10^{-10} A to 10^{-2} A, with continuously variable current output on each decade range. The current is accurate to one percent over all ranges except the two lowest ranges, where the accuracy is between one and two percent. The design utilizes only elementary operational amplifier circuitry. Three operational amplifiers and a regulated 15 V power supply are the only active circuit elements required. This simplicity of design makes construction costs one-fifth that of commercially available devices with a comparable range of currents. The power supply was designed for measuring dc current-voltage characteristics of oxygen electrodes for fuel cells.

57498 (UCID—17779(Rev.1)) **Tektronix GS-4051: MCS-8080 software system.** Gertz, K.A.; Kray, A.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jun 1978. Contract W-7405-ENG-48. 40p. Dep. NTIS, MF A01.

Portions of document are illegible.

This is a more descriptive package of information relating to the article published in Electronic Design, January 18, 1978, titled "When One μP Controls Another." This package contains a basic description of the software system, an assembled listing, and a set of schematics relating to the hardware implementation of the system. An addendum contains the GS-4051 analysis and graphics program which the chemist uses to drive the entire system. It is written in BASIC language, and is easily modifiable to handle special requirements for unusual tasks. It consists of programs and subroutines which prompt the operator to enter pertinent parameters, perform mathematical analysis of various types, graphically display data and results of analysis, and communicate with the MCS-8080. 5 figures.

57499 **Laskin aerosol generator.** Drew, R.T. (Brookhaven National Lab., Upton, NY); Bernstein, D.M.; Laskin, S. *J. Toxicol. Environ. Health;* 4: No. 4, 661-670(Jul 1978).

This paper describes construction details and operating characteristics of a nebulizer developed by Sidney Laskin and used over a period of 30 yr in various laboratories to generate respirable aerosols for whole-animal inhalation exposure studies. Under the proper operating conditions, the device is capable of producing nearly monodisperse aerosols in the respirable size range (1.5 μm volume medium diameter with a geometric standard deviation of 1.1) for long periods of time.

57500 **Development, calibration, and use of a high-flux heater in the MBS/LLL smoke chamber.** Gaskill, J.R.; Taylor, R.D.; Ford, H.W. Jr.; Miller, H.H. (Univ. of California, Livermore). *J. Fire Flammability;* 8: 160-179(Apr 1977).

A stable, radiant heat source was developed and calibrated over the range of 2 to 13 W/cm². The source is capable of determining the smoke-density development of two commonly used woods at various heat fluxes with and without piloted ignition in both a closed (NBS-type) chamber and also under four ventilation rates. The results of the tests on wood specimens indicate that a radiant flux of 5 W/cm² or greater induces rapid pyrolysis and the generation of light-obscuring particulates, resulting in higher smoke opacities than has been anticipated, even though the specimens tend to autoignite at this flux and do autoignite at higher fluxes. At these flux levels, even when piloted ignition is used, combustion seems to be inefficient judging by the dirty orange color of the flames. Mild ventilation of the chamber seems to increase the maximum smoke opacities; higher ventilations tend to clear away the smoke particulates. The variable heat-flux and ventilation capabilities of the chamber system may yield a unique approach to the evaluation of autoignition phenomena for various materials.

57501 **Compensation for thermal drift in an optical feedback stabilized photometer.** Senn, D.R. (Univ. of Georgia, Athens); Carr, P.W.; Klatt, L.N. *Chem. Instrum.;* 7: No. 2, 145-153(1976).

A simple circuit based upon an equal arm Wheatstone Bridge which senses temperature changes of the optical chassis permits compensation of thermally induced long term drift in a single beam optical feedback stabilized photometer. A drift rate of 0.004 percent T/hr was achieved.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 56406, 56590, 56591

57502 **Well logging sonde including a linear particle accelerator.** Turcotte, R.E.; Wahl, J.S. (to Schlumberger Tech. Corp.). US Patent 4,093,854. 6 Jun 1978. Filed date 16 Nov 1976. 20p.

In accordance with an illustrative embodiment of the present invention, a logging sonde includes a standing wave type microwave linear particle accelerator excited by a magnetron and producing bursts of high energy electrons which can selectively bombard either a neutron emitting target or a photon emitting target. Means are provided to sense the variations in the amplitude of the microwave field in the linear accelerator and to control the frequency of the magnetron so as to maintain the amplitude of the accelerating field at a reference value representative of the expected maximum amplitude value at resonance. Means are also provided to sense the variations in the temperature of the linear accelerator and to control the frequency of the magnetron so as to compensate for the variations in the resonant frequency of the accelerator that result from temperature induced changes the length thereof. 26 claims, 8 figures.

EXPLOSIONS AND EXPLOSIVES

57503 **Numerical study of an explosion in an elastoplastic medium and a number of problems in simulation.** Korotkov, P.F.; Prosvirnina, B.M. (Inst. of Agricultural Physics, Moscow). *Dokl. Akad. Nauk SSSR;* 1: No. 1, 66-69(1976). (In Russian).

This study considers a spherically symmetric explosion in a medium which differs minimally from an elastic medium, but does take into account one of the most important properties during an explosion, that is, its tendency for plastic flow. In this study the pressure of the products of explosion are varied by a factor of 100, while the viscosity of the medium is varied by a factor of several thousand over a series of calculations. The radius of the cavity and the size of the plastic flow region are presented as a function of the viscosity of the medium. It is concluded that the energy is the main parameter of an explosive source.

CHEMICAL

REFER ALSO TO CITATION(S) 57631

57504 (LA-UR—78-836) **Chemistry of build-up of a detonation wave.** Mader, C.L. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780813—10). Dep. NTIS, PC A02/MF A01.

From Symposium on high pressures; Paris, France (22 Aug 1978).

A carbon coagulation or condensation mechanism is compatible with the experimental observations of large changes of the effective C-J pressure of heterogeneous explosives and associated small changes in detonation velocity as a function of the distance the detonation wave has proceeded. As the distance of run increases, the Taylor wave becomes less steep and the process of carbon coagulation (C/sub gas/ → C_2 → C_6 → C/sub n/ → C/sub graphite/) has more time to proceed before the expansion of the products decreases the amount of interaction of carbon species that can occur. A model is described that is suitable for numerical modeling of the two-dimensional detonation wave build-up as a function of gradient of the Taylor wave near the detonation front.

57505 (LA-UR—78-1062) **Ignition and initiation of potassium picrate and potassium picrate/explosives mixtures.** Dinegar, R.H. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780813—7). Dep. NTIS, PC A02/MF A01.

From Symposium on high pressures; Paris, France (22 Aug 1978).

Potassium picrate (KP) and KP blended with PETN or HMX can be ignited by a hot wire. Maximum gas pressure generation occurs in several milliseconds and is about 0.3 GPa in a volume of 1 cm³. The shock from detonating PETN initiates small, brass-confined pressings of KP to steady detonation velocities of 3.5 to 5.5 km/s in the density range 1.0 to 1.6 Mg/m³. KP mixes can be employed as deflagrating donor mixtures in 2 types of electric detonators. In one the high pressure deflagration drives a stress wave into an explosive in which the deflagration is transformed into a detonation. In the other the high pressure accelerates a flying plate which initiates detonation in an acceptor explosive upon impact.

57506 (LA-UR—78-1148) **Numerical modeling of the deflagration-to-detonation transition.** Forest, C.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 21p. (CONF-780915—1). Dep. NTIS, PC A02/MF A01.

From 15. JANNAF combustion meeting; Newport, RI, USA (11 Sep 1978).

The effect of a confined porous bed of burning explosive in contact with a solid explosive is studied by computer simulation. The burning is modeled using a bulk burn model that is a function of the surface area and the pressure. Once pressure excursions occur from the confined burning the transition to detonation is modeled using a

pressure-dependent heterogeneous explosive shock decomposition model called Forest Fire. The occurrence of detonation in the solid explosive is shown to be dependent upon the surface-to-volume ratio, the confinement of the porous bed, and the geometry of the system.

57507 (LA-UR—78-1191) **Unsteady detonations driven by first-order phase transformations.** Rabie, R.L.; Fickett, W. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780813—8). Dep. NTIS, PC A02/MF A01.

From Symposium on high pressures; Paris, France (22 Aug 1978).

Reactive waves supported by the energy released during a phase transformation are examined as elementary detonations. It is found that a class of eigenvalue detonations exist containing the well known Chapman-Jouguet solution as a particular case. In general the set of eigenvalue detonations are unsteady in any single inertial reference frame.

57508 (LA-UR—78-1219) **Shock initiation study of PBX-9404.** Wackerle, J.; Rabie, R.L.; Ginsberg, M.J.; Anderson, A.B. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780813—9). Dep. NTIS, PC A02/MF A01.

From Symposium on high pressures; Paris, France (22 Aug 1978).

Pressure-field histories during the sustained and short-duration shock initiation of PBX-9404 explosive (plastic-bonded HMX) have been determined with embedded Manganin gauges. Numerical integration of the conservation relations and an assumed equation of state are used to obtain the decomposition histories during the initiation process. In both cases, this process is effected by reaction originating near the impact face producing pressure pulses that overtake the shock front and enhance its strength, leading to an abrupt transition to detonation. Correlation of reaction rates to state variables suggest an Arrhenius rate form, modified to include a dependence on shock strength and an induction time. This rate is used in computer simulations of several other initiation experiments on PBX-9404.

57509 (MLM—2551(OP)) **Self heating in consolidated Al/Cu_2O thermites.** Miller, G.D.; Mohler, J.H.; Kelly, M.D. (Mound Lab., Miamisburg, OH (USA)). [nd]. Contract EY-76-C-04-0053. 11p. (CONF-780706—15). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

The ignition theory of Frank-Kamentskii, which follows from a solution of the steady-state heat flow equation for an isotropic chemical heat source, predicts that a measurable temperature difference will be established between the center and wall of a sample that is near its ignition point. This temperature difference was measured in a cylindrical Al/Cu_2O thermite part under conditions approximating a steady-state. The results of the measurements lead to a calculation of the activation energy and a pseudo-zero order preexponential factor for the thermite reaction rate constant.

57510 (SAND—78-1001) **Synthesis of symmetrical trichlorotrinitrobenzene. Part 2. Nitrations with nitric acid; synthesis of by-products.** O'Keefe, D.M.; Gurule, F.T. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 51p. Dep. NTIS, PC A04/MF A01.

Trichlorotrinitrobenzene (TCTNB) is an intermediate in the synthesis of the insensitive explosive, TATB. TCTNB is made by the nitration of symtrichlorobenzene. We have studied this nitration to: (1) further the understanding of this reaction; (2) identify the by-products produced; and (3) allow replacement of the current nitration mixture (sodium nitrate plus fuming sulfuric acid) with an all-liquid nitration mixture. These goals have been realized. Several all-liquid nitration mixtures have been identified. Besides easier handling, these mixtures may allow reuse of the nitration mixture with a reduction in cost for TCTNB.

57511 (SAND—78-1384C) **Small fast response light fiducial.** Cooper, P.W. (Sandia Labs., Albuquerque, NM (USA)). 10 Jul 1978. Contract EY-76-C-04-0789. 15p. (CONF-780706—12). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

In response to needs for Sandia Laboratories High-Speed Sled Track, a small, fast, explosively actuated light fiducial was developed. A small burst of essentially broad spectrum white light is produced by the rapid burning of a mixture of aluminum and potassium perchlorate (approximately 60 milligrams). This mixture is both initiated by and propelled by a small charge of PETN (approximately 50 milligrams). Light rise time was determined to be on the order of ten microseconds, persistence approximately two milliseconds. The light puff forms a source approximately 50 millimeters in diameter and can be picked up on remote streak cameras over a kilometer distant. This device is compared to other EBW initiated devices in terms of output and handling safety.

57512 (UCID—17871) **Mechanical properties of thermally aged RX-03-BB.** Breithaupt, R.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

Accelerated aging studies are conducted to make predictions of the stockpile lifetime of an explosive. A thirty-two-month aging study was designed to evaluate an explosive consisting of TATB and Kel-F 800 binder. Mechanical property tests were done to determine the effects of thermally accelerated aging on the explosive. The explosive was thermally aged by two different methods. One set of samples was held at a constant temperature for a prescribed period of time. A second series of samples was thermally cycled from 92°C to -55°C with a twenty-four-hour soak at each temperature. Several physical property tests were conducted on the aged parts; only mechanical property data are discussed.

57513 (UCRL—78962) **Explosive energy coupling in ice and frozen soils.** Larson, D.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1976. Contract W-7405-ENG-48. 8p. (CONF-780739—1). Dep. NTIS, PC A02/MF A01.

From 3. conference on permafrost; Edmonton, Alberta, Canada (10 Jul 1978).

The theory of coupling of explosive energy in frozen materials is very complex and involves major nonlinear behavior of the medium, including melting, polymorphism, plastic flow and crushing of pores. Some or all of these may be rate sensitive processes. A simplification of any theoretical treatment can be made by determining the relative importance of these nonlinear processes. Experiments, when properly designed, can provide the data necessary to establish this relationship. The objectives of the paper are to present results from a series of small scale experiments on ice and frozen soils and to relate explosive energy coupling derived from these data to differences in materials properties.

57514 (UCRL—80435) **Thermal decomposition of explosives with full containment in one-dimensional geometries.** Tarver, C.M.; McGuire, R.R.; Wrenn, E.W.; Brein, K.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 39p. (CONF-780806—2). Dep. NTIS, PC A03/MF A01.

From 17. symposium on combustion; Leeds, UK (20 Aug 1978).

This paper describes some experiments designed to accurately determine the time interval required to produce the reactive event in confined explosives and propellants subjected to temperatures which will cause decomposition. Geometry and boundary conditions are both well defined so that these experiments on the rapid thermal decomposition of high explosives are amenable to predictive modeling.

NUCLEAR

57515 (UCID—17847) **KRS: a fast, special-purpose data base system.** Hage, G.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jun 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

The K-Division Retrieval System (KRS) is a group of programs and files maintained by the Lawrence Livermore Laboratory to store and recall data about the geology and events at the Nevada Test Site. KRS consists of two large data files that are regularly updated with new information. This report describes these data files and the interaction necessary to use the specialized programs, obtain access to the information, and arrange the data reports. These programs are run on CDC-7600 computers and are available in public files. 1 figure, 3 tables.

CIVIL USES

57516 (LA—7303-MS) **Row charge cratering calculations.** Miller, L.W.; Matuska, W. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

Two-dimensional calculations have been done to determine the feasibility of constructing deep canals with nuclear explosives subject to the limitation in the proposed PNE Treaty. The conditions under which a series of explosives set in a row can be approximated by a cylindrical line source have been determined. Using this result, the possibility of lifting 250 m of overburden with 150-kt charges spaced at 50-m intervals has been investigated. This study shows that for a variety of equations of state for the geological medium, there appears little possibility that such an excavation can be accomplished.

57517 **Nuclear cratering experiments: United States and Soviet Union.** Nordyke, M.D. (Lawrence Livermore Lab., CA). pp 103-124 of Impact and explosion cratering. Roddy, D.J.; Pepin, R.O.; Merrill, R.B. (eds.). New York; Pergamon Press (1977).

Both the U.S. and the Soviet Union have carried out a number of nuclear cratering experiments in a variety of geologic environments which have provided useful data for understanding the mechanics of terrestrial explosive cratering. Whereas the majority of the U.S. nuclear cratering experience has been in relatively dry unsaturated environments, all of the Soviet experience described to date is in relatively high moisture situations which were generally in a saturated condition. The range of yields studied is similar, ranging from about 100 tons to 100 kilotons. Intercomparison of the data shows a good correlation when differences in the geologic conditions are taken into consideration. No significant deviation from 3.4 root scaling appears to be required to correlate the data from these two independent bodies of cratering data.

WEAPONRY

57518 (PB—277675) **READY I system for the UNIVAC 1108 agricultural analysis programs. Final report.** (General Services Administration, McLean, VA (USA). Mathematics and Computation Lab.). Feb 1978. 60p. (GSA/FPA/MCL-TM—270). NTIS PC A04/MF A01.

Two programs in the Ready I system are specifically designed for agricultural analysis, the Crops Model and the Livestock IV Program. The Crops Model is used to determine the survivability of selected agricultural crops against a particular nuclear attack and to display the results in edited form. The Livestock IV Program computers livestock and poultry mortalities for time periods of 30 and 60 days after a nuclear attack and produces an edited analysis of the results.

EXPLOSION DETECTION

57519 (AD-A—049759) **Determination of seismic source parameters from long-period surface wave data. Technical report.** Sun, D. (Texas Instruments, Inc., Dallas (USA)). 31 Aug 1977. Contract F08606-77-C-0004. 351p. NTIS PC A16/MF A01.

Far-field Rayleigh and Love waves observed on a long-period seismic network were studied to characterize presumed underground nuclear explosions. These occurred at the United States Nevada Test Site (NTS), the Russian eastern Kazakh (EKZ) region, and at the site of presumed peaceful nuclear explosions (PNE) in the north Caspian Sea region. The observation stations available for this study included Alaskan Long Period Array (ALPA), Large Aperture Seismic Array (LASA), Norwegian Seismic Array (NORSAR), the Very Long Period Experiment (VLPE) stations, the Seismic Research Observatories (SRO), and the Special Data Collection System (SDCS) stations. The purpose of this study was to determine the seismic source parameters from long-period surface wave data and to investigate the influence of geological and near-source propagation effects on the frequency content of the surface wave signals.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 57062, 57063, 57653

57520 **Environmental responsibility: education and research.** Sinker, C.A. pp 9-15 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

The following topics are discussed: activities of the Field Studies Council; the role of research personnel and teachers of environmental sciences; importance of everyone taking responsibility for the environment; and importance of commitment, honesty, and desire to communicate in teachers and scientists. (HLW)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 56394, 56396, 56400, 56458, 56558, 57270, 57626

57521 (AD-A—051444) **Fourier transform infrared spectroscopy: demonstration of measurement capabilities in the laboratory and the field. Research memo.** Reed, R.A. (Grumman Aerospace Corp., Bethpage, NY (USA). Research Dept.). Jan 1978. 30p. (RM—648). NTIS PC A03/MF A01.

The measurement capabilities of an infrared interferometer spectrometer are documented for both field and laboratory usage. This instrument provided intermediate resolution coverage (0.3/cm to 5/cm) in the 1.6 to 5.4 micrometer spectral interval. It has been used in the field to study radiation from aircraft exhaust plumes, background emission, and atmospheric transmission. In the laboratory, line spectra of flames have been measured and nonequilibrium vibrational temperatures derived. System configuration, operating procedure, and data processing are discussed. The performance of the interferometer is illustrated by typical spectral data. (Author)

57522 (BNL—50786) **Acid rain research program. Annual progress report, July 1976—September 1977.** Evans, L.S.; Francis, A.J.; Raynor, G.S. (Brookhaven National Lab., Upton, NY (USA)). Dec 1977. Contract EY-76-C-02-0016. 109p. Dep. NTIS, PC A06/MF A01.

Experiments were carried out and chemical aspects of ambient precipitation were determined using a sequential precipitation collector for the period July 1976 through September 1977. A related report provides experimental details. In experiments with plants, experiments were aimed to document: the foliar response of six clones of hybrid poplar to simulated acid rain; effects of buffered solutions and various anions on vegetative and sexual development of gametophytes of the fern (Pteridium aquilinum) and the acid-sensitive steps of symbiotic nitrogen fixation of the garden pea (Pisum sativum). After five 6 min daily exposures to simulated rain of pH 2.7, up to 10 percent of the leaf area of some poplar clones was injured. Lesions developed mostly near stomata and vascular tissue as shown with other plant species. Acidic solutions have a marked effect on sperm motility and fertilization (sexual reproduction) of bracken fern. Since sexual reproduction of ferns is very sensitive to mildly acidic conditions under laboratory conditions, experiments are planned to view the response of sexual stages of other plant species. Nodulation and symbiotic nitrogen fixation in Pisum is very sensitive to nutrient solution acidity. Specific isolates of Rhizobium bacteria are used and the medium pH can be maintained rigidly. In experiments to determine the effects of excess acidity on soil microbiological processes, the rate of denitrification may be slowed so drastically that increases of N_2O in the atmosphere may result with a subsequent reduction in soil nitrogen levels.

57523 (BNWL-SA—6370) **Wet removal of sulfur compounds from the atmosphere.** Hales, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 34p. (CONF-770909—3). Dep. NTIS, PC A03/MF A01.

From International symposium on sulfur in the atmosphere; Dubrovnik, Yugoslavia (7 Sep 1977).

Portions of document are illegible.

Wet removal of sulfur dioxide and sulfate from the atmosphere constitutes an important component of the global sulfur balance. Sulfur deposition in the northern hemisphere is increasing with fossil fuel utilization, and has been related with severe impact on soils and surface waters in specific instances. The majority of sulfur in rainfall occurs as sulfate, although dissolved sulfur dioxide (sulfite) can contribute significantly under many conditions. This paper presents a brief overview of our current capability to calculate sulfur scavenging rates. The general wet removal process can be decomposed into several individual pathways. These include direct sulfur dioxide scavenging, direct sulfate scavenging, and combined scavenging and chemical reaction. Modeling approaches for these pathways are discussed, and pertinent research areas for improvement of our present modeling capability are recommended.

57524 (FAA-AEQ—77-14A) **Concorde air quality monitoring and analysis program at Dulles International Airport. Volume II. Appendixes. Final report, June 1976—December 1977.** Smith, D.G.; Yamartino, R.J.; Benkley, C.; Isaacs, R.; Lee, J.; Chang, D. (Environmental Research and Technology, Inc., Concord, MA (USA)). Dec 1977. Contract W-31-109-ENG-38. 161p. Dep. NTIS, MF A01.

Portions of document are illegible.

On February 4, 1976, the Secretary of Transportation ordered the FAA to monitor Concorde emissions at Dulles International Airport during its initial 16 month trial period. To comply with this order, it was necessary to measure the ambient pollution levels (background) in and around Dulles Airport and to trace the dispersion of emissions from a single Concorde aircraft. While the more conventional background measurements could be easily performed, there was no known case where the vertical and horizontal profile of the emission plume from a single aircraft had been identified. Special instruments were required to measure the discrete, non-steady nature of the dispersion of the aircraft plume. The final measurement system, which consisted of continuously recording electro-chemical sensors coupled with high-speed chart recorders, successfully detect-

ed CO emissions from a single aircraft. Concorde CO emissions from taxiing aircraft dilute to background levels within 2,000 ft and do not reach the terminal in measurable amounts. Emissions from the airport property could not be detected at Sterling Park, or several more distant communities, even when the winds were blowing toward them from the airport. Actual Concorde operations are less polluting than had been indicated in the Final Environmental Impact Statement (FEIS).

57525 (LA—7393-MS) **Estimation of expected value and coefficient of variation for lognormal and gamma distributions.** White, G.C. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 84p. Dep. NTIS, PC A05/MF A01.

Concentrations of environmental pollutants tend to follow positively skewed frequency distributions. Two such density functions are the gamma and lognormal. Minimum variance unbiased estimators of the expected value for both densities are available. The small sample statistical properties of each of these estimators were compared for their own distributions, as well as for the other distribution, to check the robustness of the estimator. The arithmetic mean is known to provide an unbiased estimator of expected value when the underlying density of the sample is either lognormal or gamma, and results indicated the achieved coverage of the confidence interval is greater than 75 percent for coefficients of variation less than two. Further Monte Carlo simulations were conducted to study the robustness of the above estimators by simulating a lognormal or gamma distribution with the expected value of a particular observation selected from a uniform distribution before the lognormal or gamma observation is generated. Again, the arithmetic mean provides an unbiased estimate of expected value, and the achieved coverage of the confidence interval is greater than 75 percent for coefficients of variation less than two.

57526 (LBL—7817(Rev.)) **Design of a mobile laboratory for ventilation studies and indoor air pollution monitoring.** Berk, J.V.; Hollowell, C.D.; Lin, C.I.; Pepper, J.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 53p. Dep. NTIS, PC A04/MF A01.

A mobile laboratory for research and development studies of ventilation requirements and energy utilization in residential and commercial buildings was designed and fabricated. The mobile laboratory contains sampling, calibrating, and monitoring systems to measure the concentration of CO, CO_2, NO, NO_2, NO/sub x/, O_3, and SO_2, and infiltration rates can be monitored continuously using a tracer gas system in which the tracer is injected into the room, mixed with room air, and monitored.

57527 (LBL—7832) **Combustion-generated indoor air pollution.** Hollowell, C.D.; Traynor, G.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 13p. (CONF-780490—1). Dep. NTIS, PC A02/MF A01.

From 13. colloquium on polluted atmospheres; Paris, France (25 Apr 1978).

The indoor air quality of residential buildings was characterized to determine the types, rates of emissions, and fates of gaseous and particulate air pollutants from typical indoor combustion appliances. Measurements were conducted in occupied residential buildings and during controlled laboratory experiments with combustion appliances. The SO_2, NO, NO_2, O_3, CO, and CO_2 concentrations and aerosol size distribution were determined on a continuous basis. Total and respirable-fraction particulate samples were collected on membrane filter media for analysis by x-ray fluorescence (XRFA), photoelectron spectroscopy (ESCA), proton activation analysis (PAA), combustion, and wet-chemistry techniques for the determination of particulate elemental composition (S, N, C, etc.) and ionic species such as SO_4^{2-}, NO_3^-, and NH_4^+. Results of the study indicate that the concentrations of some gaseous and respirable particulate air pollutants in the indoor environment exceed those levels commonly found in the outdoor urban air environment. Such findings may have a large impact on the future design of epidemiology studies, on energy conservation strategies for buildings, and on the need for more stringent control of air pollution from indoor combustion sources.

57528 (NTIS/PS—78/0297) **Coke oven air and water pollution (citations from the Engineering Index data base). Report for 1970—March 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 177p. NTIS PC N01/MF N01.

Monitoring, sampling, analyzing, transport properties, and control of emissions and effluents are cited in this compilation from worldwide journals. Pollutants described are sulfur dioxide, hydrogen sulfide, ammonia, phenols, benzopyrene, particulates and other trace elements and compounds. Process and equipment modifications, such as pipeline charging, wet and dry quenching, retrofitting, and oven leakage preventives are included. (Contains 170 abstracts)

57529 (PB—276718) **Source assessment: synthetic ammonia production. Final report August 1975—September 1977.** Rawlings, G.D.; Reznik, R.B. (Monsanto Research Corp., Dayton, OH (USA)). Nov 1977. Contract EPA-68-02-1874. 85p. (MRC-DA—736). NTIS PC A05/MF A01.

The report describes a study of air emissions from the production of synthetic ammonia. In 1976, 90 synthetic ammonia plants in 30 states produced 15.2 million metric tons of anhydrous ammonia. Ammonia is synthesized by the reaction of nitrogen and hydrogen. Most plants produce hydrogen by the catalytic steam reforming of natural gas. An average ammonia plant has a capacity of 180,000 metric tons/year. Plant air emissions result from regeneration of the desulfurization tank, from combustion in the primary reformer, from regeneration of the CO_2 scrubbing solution, and from steam stripping of process condensate. On the average, emissions from the regeneration of the desulfurization tank are released for 10 hours, but only once every 30 days; emissions from the other sources are continuous during plant operation. These emission points are not controlled because no state or federal standards are exceeded. Process modifications have reduced air emissions and improved utilization of raw materials and energy. Potential environmental effects from ammonia plant emissions were measured: highest continuous source severities result from NOx emissions from the primary reformer (4.1), and ammonia emissions from the regeneration of the CO_2 scrubbing solution (2.2) and from the condensate steam stripper (3.2). Annual ammonia production should increase by 4-8% through 1980. Industry emissions should also increase at this rate.

57530 (PNL-SA—6721) **Model for predicting dry deposition of particles and gases to environmental surfaces.** Sehmel, G.A.; Hodgson, W.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1978. Contract EY-76-C-06-1830. 44p. (CONF-780611—10). Dep. NTIS, PC A03/MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

A predictive model is demonstrated for correlating particle and gas removal rates from the atmosphere by dry deposition. Predicted deposition rates can vary over several orders of magnitude and are complex functions of pollutant, air, and surface variables. The validity of many published field deposition measurements is discussed in terms of these complexities.

57531 (UCRL—81512) **Enhanced filtration program at LLL. A progress report.** Bergman, W.; Taylor, R.D.; Miller, H.H.; Bierman, A.H.; Hebard, H.D.; daRoza, R.A.; Lum, B.Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jul 1978. Contract W-7405-ENG-48. 41p. (CONF-780819—18). Dep. NTIS, PC A03/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

As part of Lawrence Livermore Laboratory's Enhanced Filtration Program, we are investigating the use of an externally applied electric field to improve the performance of fibrous filters. Our objective in this program is to develop filtration systems for the nuclear industry that will reduce the cost and volume of nuclear waste associated with present systems. We have developed a new theory of the electrostatic filter that is consistent with experimental tests made during transient and steady-state conditions. For these tests, we used ac and dc electric fields, insulated and noninsulated electrodes, and conducting and nonconducting filter media; all tests were conducted in our small-scale 25 l/s test system, using sodium chloride aerosols. Our theory employs a new mechanism based on the attraction between charged particles and charged fibers in addition to the previously proposed mechanism based on the attraction between charged particles and polarized fibers. In this theory, fibers are charged when charged particles deposit on them. We have also developed a theoretical model that explains the increase in filter efficiency and pressure drop when particles load on the filter. The filter loading tests we conducted to evaluate this model verify its accuracy to a remarkable degree. By using the model equations, we are thus able to explain the observed increase in filter efficiency as a function of particle mass loading, particle size, and particle-particle collection efficiency. Two systems we developed for use in the nuclear industry use electric fields to increase the performance of fibrous filters. One is designed for use inside glove boxes to control radioactive particles at their source; the other is designed for use in ventilation systems. Here we report the results of laboratory and field evaluations for the glove box system.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 57254, 57608, 57614

57532 (CONF-780740—2) **Radiological and environmental studies at uranium mills: a comparison of theoretical and experimental data.** Momeni, M.H.; Kisieleski, W.E.; Yuan, Y.; Roberts, C.J. (Ar-

gonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From Management, stabilization, and environmental impact of uranium mill trailings; Albuquerque, NM, USA (24 Jul 1978).

Evaluation of radiological risk of uranium milling is based on identification and quantification of sources of release and consideration of dynamic coupling among the meteorological, physiographical, hydrological environments and the affected individuals. Dispersion pathways of radionuclides are through air, soil, and water, each demanding locally tailored procedures for estimation of the rate of release of radioactivity and the pattern of biological uptake and exposure. The Uranium Dispersion and Dosimetry Code (UDAD), a comprehensive method for estimating the concentrations of the released radionuclides, dose rates, doses, and radiological health effects, is described. Predicted concentrations and exposure rates are compared with experimental data obtained from field research at active mills and abandoned tailings.

57533 (DPSPU—78-30-11) **Environmental sampling accounting at the Savannah River Plant.** Zeigler, C.C.; Wood, M.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1978. Contract EY-76-S-09-0001. 18p. (CONF-780657—2). Dep. NTIS, PC A02/MF A01.

From 23. meeting of the Health Physics Society; Minneapolis, MN, USA (18 Jun 1978).

At the Savannah River Plant Environmental Monitoring Laboratories, a computer-based systematic accounting method was developed to ensure that all scheduled samples are collected, processed through the laboratory, and counted without delay. The system employs an IBM 360/195 computer with a magnetic tape master file, an on-line disk file, and cathode ray tube (CRT) terminals. Scheduling and accounting are accomplished by using computer-generated schedules, collection labels, and output/input cards. For each scheduled sample and analysis, a printed card is issued for collection, laboratory analysis, and counting. The cards also contain information needed by personnel performing the jobs, such as sample location, aliquot to be processed, or procedure number. Manual entries are made on the cards when each step in the process is completed. Additional pertinent data are also manually entered on the cards; e.g., entries are made explaining why a sample is not collected, the sample aliquot in the event a nonstandard aliquot is processed, field measurement results, and analytical results. These manually entered data are keypunched and read into the computer files. The computer files are audited daily, and summaries of samples not processed in pre-established normal time intervals are issued. The progress of sample analyses can also be readily determined at any time using the CRT terminal. Historic data are also maintained on magnetic tape and workload summaries are issued showing the number of samples and number of determinations per month.

57534 (GJT—22) **Radiation pathways and potential health impacts from inactive uranium mill tailings.** (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Jul 1978. Contract EY-76-C-13-1658. 117p. Dep. NTIS, PC A06/MF A01.

Radiation exposure pathways and potential health impacts were estimated as part of the evaluation of radioactive uranium mill tailings at the sites of inactive mills in eight western states. The purpose of this report is to describe in detail the methodology used in performing the pathway analysis and health effects estimations. In addition, specific parameters are presented for each of the 22 uranium mill sites that were evaluated. A computer program, RADAD, developed as part of this program, is described and listed.

57535 (NVO—269-34) **Amchitka Radiobiological Program. Progress report, January 1977—December 1977.** Seymour, A.H.; Johnson, A.F. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). Jul 1978. Contract EY-76-S-08-0269. 57p. Dep. NTIS, PC A04/MF A01.

The Amchitka Radiobiological Program began in 1970 and is a continuing program to collect biological and environmental samples for radiometric analyses. An account of the program from July 1970, to December 1976, has been given in seven previous progress reports from the Laboratory of Radiation Ecology to the Nevada Operations Office of the U.S. Department of Energy. This report is an account of the program for calendar year 1977. Results of analyses for samples collected in September 1977 have been added to the tables in Nelson and Seymour (1977) that summarize the results of analyses of samples collected from 1970 to 1977, and include analyses for: gamma-emitting radionuclides in air filters, freshwater, birds, lichens, marine algae, marine invertebrates, fish, aufwuchs, and freshwater moss and plants; strontium-90 (^{90}Sr) in rats, birds, and soil; ^{239,240}Pu in sand, soil, marine algae, and fish; and tritium (^{3}H) in seawater, freshwater, and biological organisms. Monitoring of background radiation with survey instruments was added to the Laboratory's program in 1974, and the results of the four annual surveys since that date are included in this report. Conclusions from the results of the recent analyses are a reiteration of the results stated in Nelson and Seymour (1975a); namely, no new radionuclides are present; the most abundant radionuclides are naturally occurring beryllium-7 [^{7}Be] and potassium-40 [^{40}K]; the trace quantities of fission products and induced radionuclides are from world fallout; and a trace of ^{3}H contamination remains in some Long Shot ponds, as previously reported." It is concluded from the results of analyses of samples collected between September 1969, and September 1977, as reported in this and the seven previous progress reports, that there were no radionuclides of Milrow or Cannikin origin in the water, plants, or animals of Amchitka Island.

57536 (PNL-SA—6720) **Plutonium concentrations in airborne soil at Rocky Flats and Hanford determined during resuspension experiments.** Sehmel, G.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1978. Contract EY-76-C-06-1830. 23p. (CONF-771109—109). Dep. NTIS, PC A02/MF A01.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

Plutonium resuspension results are summarized for experiments conducted by the author at Rocky Flats, onsite on the Hanford reservation, and for winds blowing from offsite onto the Hanford reservation near the Prosser barricade boundary. In each case, plutonium resuspension was shown by increased airborne plutonium concentrations as a function of either wind speed or as compared to fallout le/els. All measured airborne concentrations were far below maximum permissible concentrations (MPC). Both plutonium and cesium concentrations on airborne soil were normalized by the quantity of airborne soil sampled. Airborne radionuclide concentrations in μCi/g were related to published values for radionuclide concentrations on surface soils. For this ratio of radionuclide concentration per gram on airborne soil divided by that for ground surface soil, there are eight orders of magnitude uncertainty from 10^{-4} to 10^{4}. This uncertainty in the equality between plutonium concentrations per gram on airborne and surface soils is caused by only a fraction of the collected airborne soil being transported from offsite rather than all being resuspended from each study site and also by the great variabilities in surface contamination. Horizontal plutonium fluxes on airborne nonrespirable soils at all three sites were bracketed within the same four orders of magnitude from 10^{-7} to 10^{-3} μCi/(m^2 day) for ^{239}Pu and 10^{-6} to 10^{-5} μCi/(m^2 day) for ^{238}Pu. Airborne respirable ^{239}Pu concentrations increased with wind speed for a southwest wind direction coming from offsite near the Hanford reservation Prosser barricade. Airborne plutonium fluxes on nonrespirable particles had isotopic ratios, ^{240}Pu/^{239,240}Pu, similar to weapons grade plutonium rather than fallout plutonium.

57537 (UCID—17853) **Sampling and analytical procedures for environmental monitoring at Lawrence Livermore Laboratory.** Lindeken, C.L.; Wong, K.M.; Seibel, G.L.; Griggs, K.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jul 1978. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

Described herein are sample collection and analysis procedures employed in environmental monitoring at the Lawrence Livermore Laboratory. An integral part of the quality assurance program developed for environmental monitoring at Livermore, these procedures provide a basis for verifying that sampling and analytical activities are being performed as specified.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 57484

57538 **Parametrization and preprocessing of ocean color image data for studies of coastal oceanography.** Mueller, J.L. (Goddard Space Flight Center, Greenbelt, MD); Ball, D.L.; Middleton, E.M. pp 295-302 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Methods are presented for processing ocean color image data into forms suitable for quantitative oceanographic studies. A radiative transfer technique is outlined for determining approximate corrections for atmospheric transmission, atmospheric path radiance, sun glitter, and skylight reflection from the sea surface as functions of scan angle. The radiometric accuracy of these corrections is perhaps no better than +- 20%, but they nevertheless serve to make an overall relative correction for the systematic scan-angle dependent radiance variations with which these effects badly mask the ocean color pattern in images. Further processing methods include removal of geometric scan distortions from each image, and geographic registration (accurate to 0.5 km, or a single pixel) using visible landmarks. Work in progress to account for effects of bottom reflectance in ocean color spectrum analyses is reviewed. Experimental results with ocean color spectra from different world loca-

tions suggest that it may be possible to standardize the parametrization of ocean color spectra with characteristic vectors.

REGULATIONS

REFER ALSO TO CITATION(S) 57060, 57091

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 56646, 57520, 57565

57539 Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978). 248p. (CONF-760580—P5).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Separate abstracts were prepared for the 22 papers presented at this symposium.

57540 Need for broad-based studies of natural populations of small mammals. Snyder, D.P. (Univ. of Massachusetts, Amherst). pp 1-2 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Although experiments and observations under various restrictive conditions are frequently necessary, wider use of an experimental approach in which both control and experimental groups are free-ranging populations is suggested. A broad range of characteristics should be studied through time and over the geographic range of a species. We need simultaneous measurements on individuals within populations, and we need to observe different populations simultaneously. Hypotheses developed from such studies would not be as subject to refutation as those based on less representative data. Studies of this kind are expensive, but the potential for increasing our understanding of populations could justify a well planned program. Without a framework which incorporates all aspects of a population we are in danger of continuing to obtain partial answers which cannot be integrated into a common theory.

57541 Experimental designs and statistical analyses in small mammal population studies. Hayne, D.W. (North Carolina State Univ., Raleigh). pp 3-10 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

An arbitrary selection of recent American papers on small mammal populations shows, first, that the experimental method is not often used, and second, that the more frequent descriptive studies are mostly unreplicated (not repeated). The experimental method can be used for only part of the problem of the field, but where it can be used it has logical advantages. In planning an experiment, one must determine whether the investigative resources can support a test powerful enough to detect differences at a worthwhile level. If such differences cannot be detected then the experiment should not be run. An unreplicated descriptive study provides no indication of how different might be the result of a similar study carried out elsewhere. Under these conditions the investigator has only experience and intuition to guide judgement of how generally the conclusions may be extrapolated and there is some danger that hypotheses may be advanced without real support. Even a single repetition of a study can show how variable the results may be and thus promote caution in interpretation. In this way repetition is useful even where the number of replications is insufficient to support any precise estimate.

57542 Use of models in small mammal population studies. Conley, W.; Nichols, J.D. (New Mexico State Univ., La Cruces). pp 14-37 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

The role of models as contributors to the understanding of natural populations of small mammals is reviewed. A philosophy of model use and projections for future work are also included. Categories of biological phenomena reviewed include models on population dynamics (demographic variables and population regulation, dispersal, sex-ratios, predation, population cycles), population responses to environmental conditions, genetics of small mammal populations, competitive interactions, ecosystems and small mammal functions, and control and management of small mammal populations.

57543 Competition between species of small mammals. Grant, P.R. (McGill Univ., Montreal). pp 38-51 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Interspecific competition has often been inferred from its results. In evolutionary time it has been responsible for patterns of regularity in the structure of mammalian communities, and in the morphological and ecological characteristics of the constituent species. In contemporary time it gives rise to reciprocal (complementary) numbers and distributions of two or more species. These inferences are strengthened by recent experimental demonstrations of competition between species of North American rodents. Recent observations and experiments are reviewed. The most thoroughly studied competitors are two species of microtine rodents, Microtus pennsylvanicus and Clethrionomys gapperi. Species which compete for space have been studied experimentally more often than have food competitors. Overt aggression is frequently implicated, but its importance in nature in relation to other means of interaction (e.g. through vocal or scent communication) is not known. The definitive study of competition for food between mammal species has yet to be performed.

57544 Effects of mammalian competitors on the ecology and evolution of communities. Brown, J.H. (Univ. of Arizona, Tucson). pp 52-60 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Competitive interactions with other species influence the abundance, distribution, and evolution of small mammal populations. In some cases, closely related species exclude each other from local habitats by direct, aggressive interference; in others, they coexist by differentially exploiting limiting resources and avoiding interspecific aggression. Selection to reduce competition has resulted in the evolution of differences in resource utilization among coexisting species. Regular patterns of character displacement are particularly evident in communities of closely related granivores, frugivores, and carnivores. Recent evidence suggests that small mammals compete significantly with distantly related taxa of vertebrates and invertebrates. Such interactions may have important consequences for the structure and function of natural ecosystems.

57545 Small mammals as components of the consumer subsystem. French, N.R. (Colorado State Univ., Fort Collins). pp 61-67 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

The trophic and species composition of small mammal populations in various environments are related to structural complexity of the plant community. The basis for these relationships is in energetics, abundance, and dependability of food resources determining the potential patterns of exploitation possible. There is evidence for resource partitioning by small mammals in grasslands, but development of suitable strategies are dependent upon demographic characteristics. Energetic efficiency of small mammals and invertebrates is examined as it affects their relative success as consumers in grasslands. The relative importance of small mammals, birds, and arthropods in relation to utilization of plant herbage, seeds, and invertebrate food resources is estimated for five grassland sites. Recommendations are made for topics meriting further investigation.

57546 Implications of a conceptual model for the allocation of energy resources by small mammals. Wunder, B.A. (Colorado State Univ., Fort Collins). pp 68-75 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

This paper presents a conceptual model describing the manner in which small mammals utilize energy and the ways in which the physical environment influences allocation of energy resources. It is suggested that for homeothermic mammals, thermoregulation is a first priority for energy utilization and feeding a second priority. Once these needs are met additional energy gathered may be allocated to production or other behaviors. Deductions from the model, coupled with conclusions from field studies of weather effects on small mammal reproduction and the effects of supplemental feeding experiments on reproduction, suggest that many difficulties in interpreting such studies may be due to inattention to the interactive effects of food and weather on reproduction.

The paper then describes the manner in which three sorts of environments (subarctic-boreal, north temperate grassland, and deserts) vary seasonally in their productivity and level of cold stress for small mammals.

57547 Role of small mammals in ecosystems. Golley, F.B. (Univ. of Georgia, Athens). pp 76-83 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Small mammals are one of the groups commonly studied as an ecological unit in ecosystem analysis; the aggregation being justified on taxonomic or methodological grounds. Since small mammals include animals with habits of herbivory, omnivory, and carnivory, nocturnal and diurnal habits, living in a great variety of habitats, and adapted to conditions of life such as burrowing and flight, the collection is a diverse taxonomic aggregation and an unusually bad ecological grouping. For ecosystem analysis, groupings of organisms that have evolved in common with each other in the community seem more reasonable than aggregations based on taxonomic grounds. The depth of the problem is made clear when we examine the record and find that there are almost no studies of energy and material flow in terrestrial food chains. It is incredible that almost every study of a population considers that population as a receiver and donor of energy and materials acting independently. It would appear that aggregation of food chains into ecosystem components might be more fruitful than aggregation of independent populations.

57548 Physiological and behavioral responses to the social environment. Davis, D.E. pp 84-91 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Physiological and behavioral reactions to the social environment are mediated in nature principally through aggressive interactions, although in some cases other aspects of the environment such as temperature or predators are important. Observations from 1946-50 of changes in populations of rats after alteration of social conditions suggested the hypothesis that changes in birth and mortality rates followed aggressive interactions. The pituitary-adrenal-gonadal mechanism provided a process that could be tested in three types of conditions: laboratory, simulated field, and field. Changes in social environment can result from: seasonal changes in conditions; appearance of transients; habitat changes due to succession; and increase of population. It became apparent from laboratory research that a physiological feedback from aggressive behavior could reduce birth rates and increase mortality rates. Studies in nature showed that a reduction of Norway rat population by 38 percent was followed by a reduction of adrenal weight by 32 percent. Also as the population of rats increased the weight of the adrenals increased. A comprehensive study of woodchucks, started in 1957, showed that the alteration of age composition and the increase in immigration was associated with increased adrenal function. Research by others on lemmings shows that the adrenals at the peak of a population fluctuation are larger and produce more hormones than at the low point. No evidence was obtained to support the hypothesis that genetic selection for aggressive behavior within the population occurs during the increase or decline of a population. The changes occur within an individual. The future of studies of responses to the social environment will require experimental programs in nature that last for a decade or more, long enough to monitor changes in numbers under a variety of conditions.

57549 Social stress and population cycles: an assessment. Novak, M.A. (Univ. of Massachusetts, Amherst). pp 92-98 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Social stress is a population hypothesis that is invoked to explain the precipitous declines observed in population levels of such rodent species as Microtus pennsylvanicus. According to this hypothesis, stress is produced by the increase in aggressive contacts between animals in a growing population. Continued contacts produce profound hormonal and behavioral changes in these animals which lead to decreases in reproduction and viability. Several theoretical weaknesses of the hypothesis are raised. First, increases in density may not be positively correlated with the number of contacts. Animals may merely build more runways. Second, even if contacts do increase, they may not necessarily be aggressive in nature. Finally, confined populations which reach excessively high densities and for which contacts between animals must increase, fail to show a precipitous decline in numbers. In addition, a major methodological problem is revealed. Although researchers tend to causally connect social stress and precipitous population declines, most studies are correlational in nature. Of those studies that involve actual manipulations of populations, these manipulations are usually performed on confined populations that fail to exhibit the desired phenomonen. The difficulties associated with manipulating unconfined populations are discussed.

57550 Spatial and temporal dynamics of the genetic organization of small mammal populations. Smith, M.H. (Savannah River Ecology Lab., Aiken, SC); Manlove, M.N.; Joule, J. pp 99-113 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

A functional population is a group of organisms and their offspring that contributes to a common gene pool within a certain area and time period. It is also the unit of evolution and should be viewed both in quantitative and qualitative terms. Selection, drift, dispersal, and mutation can alter the composition of populations. Spatial heterogeneity in allele frequencies argues for a conceptual model that has a series of relatively small populations semi-isolated from one another. Because of the relatively high levels of genetic variability characteristic of most mammalian species, significant amounts of gene flow between these spatially subdivided populations must occur when longer time periods are considered. Fluctuations in the genetic structure of populations seem to be important in altering the fitness of the individuals within the populations. The interaction of populations through gene flow is important in changing the levels of intrapopulational genetic variability. Populations can be characterized as existing on a continuum from relatively stable to unstable numbers and by other associated changes in their characteristics. Temporal changes in allele frequency occur in a variety of mammals. Conceptually, a species can be viewed as a series of dynamic populations that vary in numbers and quality in both a spatial and temporal context even over short distances and time periods. Short term changes in the quality of individuals in a population can be important in altering the short term dynamics of a population.

57551 Genetical pressures and social organization in small mammal populations. Berry, R.J. (Univ., London). pp 114-121 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Inherited variation is often useful for detecting and measuring ecological pressures in natural populations. For example, changes in allele and genotypic frequencies at the gene locus controlling the haemoglobin β chain in Mus musculus samples trapped on an isolated Welsh island have provided information about different mechanisms of death at different times of year and about the influence of social structure on genetical constitution. Notwithstanding, considerable caution has to be exercised in interpreting genetical changes, since detectable varients are often no more than linked markers of physiologically important gene loci, while habitat, deme, or ageing differences may be obscured in pooled data, such as are represented by concepts like overall allozymic heterozygosity. For these reasons, genetical studies on wild populations are likely to be most profitable when the contribution of individual genes to physiological or behavioral traits can be analyzed; it is at this level that genetics and ecology properly complement each other.

57552 Regulation of numbers in small mammal populations: historical reflections and a synthesis. Lidicker, W.Z. Jr. (Univ. of California, Berkeley). pp 122-141 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Five principles for population density determination are proposed which, hopefully, provide a conceptual basis on which to discuss real disagreements and future directions. Environmental and organismal influences on density can be classified into three categories: regulatory, non-regulatory, and anti-regulatory. Semantic difficulties associated with the terms density dependent and independent factors, carrying capacity, and K are discussed. Major intellectual pathways in this field are outlined, beginning approximately 50 years ago. Important themes were: the biotic-abiotic controversy, the prevailing influence of reductionist concepts, the extrinsic-intrinsic controversy, and the gradual acceptance of reproduction and emigration as demographically important variables. The increasing appreciation of holistic perspectives is viewed as a constructive and indeed essential development.

57553 Neurobehavioral endocrine regulation of small mammal populations. Christian, J.J. (State Univ. of New York, Binghamton). pp 143-158 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

A brief review is given of the hypothesis that density-dependent behavioral-endocrine negative feedbacks can regulate and often limit the growth of populations of many species of small mammals. Recent laboratory studies are summarized that show how stress, particularly psychogenic, which results in increased adrenocortical secretion also alters gonadotropin secretion and inhibits reproduction. Chronic stress due to crowding, immobilization, et al. inhibits the release of LH and FSH, particularly by abolishing the pulsatile release of LH, and also causes a rise in prolactin (at least acutely). Stimulation of the hypothalamo-pituitary-adrenocortical system is accompanied by an inversely proportional inhibition of growth hormone secretion. Decreasing photoperiod enhances the sensitivity of the hypothalamus to inhibition of gonadotropin secretion by androgens and estrogens. Other endocrine responses to increased density or subordinate social rank also are summarized. How these facts fit into the negative feedback scheme is discussed, including the greatly prolonged effects of diminished lactation. The changed quality of the animals associated with changes in density discussed by Lidicker also can be explained by the above responses to density. Data on changes in growth and reproductive function which are consistent with the behavioral-endocrine feedback hypothesis are presented for several populations of small mammals, including some previously unpublished data for Microtus pennsylvanicus.

57554 Defense of single-factor models of population regulation. Tamarin, R.H. (Boston Univ.). pp 159-166 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

I reject a multifactorial approach to the study of the regulation of animal populations for two reasons. First, a mechanism suggested by Chitty, that has natural selection at its base, has not been adequately tested. Second, the multifactorial model suggested by Lidicker is untestable because of its vagueness. As a middle ground, I suggest a model that has natural selection as its mechanism, but is multifacturial because it allows many parameters to be the selective agents. I particularly emphasize prediction and selective dispersal. Methods to test this model are suggested.

57555 Impact of small mammals in ecosystemm structure and function. Chew, R.M. (Univ. of Southern California, Los Angeles). pp 167-180 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

This article is concerned with the evaluation of the effects of small mammals on the characteristics of ecosystems, as a matter of basic scientific importance, and of necessity in a humanly managed biosphere. The review emphasizes literature in which there is experimental demonstration of effects of small mammals, strong circumstantial evidence for an effect, and indication of a possible effect in an unstudied relationship. Our knowledge of interactions is very incomplete. Studies are needed that emphasize the responses of vegetation (production, composition, population dynamics) to the measured actions of mammals. Attention needs to be given to ways in which mammals may regulate processes that are important to plants (nutrient cycling, seed dispersal, predation) as well as actions that may directly affect plant populations (feeding, cutting, trampling). More use is indicated for experimental methods in field studies, particularly the removal of mammalian populations, which may reveal unique mutualistic relationships of vegetation and small mammals. Studies need more integration of efforts of various kinds of biologists, and a longer time span, than has occurred in the past.

57556 Effect of small mammals on forest ecosystem structure and function. Potter, G.L. (Engineering-Science, Inc., Arcadia, CA). pp 181-191 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Information is presented on the possible impacts of small mammals in temperate forest ecosystems. Studies reviewed here suggest that small mammals have a minimal role in influencing forest ecosystem processes. Their effect on energy flow patterns and nutrient dynamics of forests appears minimal in view of the relatively small amounts of energy and nutrients acted upon by small mammals. Significant effects of small mammals as herbivores and granivores tend to be limited to early successional stages when trees are young and most susceptible to damage and when seed and seedling mortality are more likely to be of consequence. They appear to have a minimal impact on vegetation in mature forests. Small mammals are a major constituent in the diet of many avian and mammalian predators and may be important in maintaining higher trophic levels in forests. They may exert some influence on forest floor invertebrates, but the long-term effects of this action on forests are not understood.

57557 Some concepts in the management and control of small mammal populations. Wagner, F.H. (Utah State Univ., Logan). pp 192-202 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

This review discusses some broadly ecological aspects of small mammal management and some positive values of their populations. Although small mammals consume a minor fraction of the total primary production in terrestrial ecosystems, they may by preferential feeding on a few plant species suppress those species within a community. The overall lifeform of the vegetation may not be changed. In cases where severe disturbance (e.g., grazing) reduces climax vegetation (e.g., grasses), and these are replaced by seral species of a different life form (e.g., shrubs), the vegetation may be held in a seral stage by heavy, small mammal pressure on the now subdominant, climax species. They may thus maintain a different vegetation life form than would exist in the absence of their pressure, and restoration of a near-climax state may depend on intensive control. There is a large accumulation of information on small mammal species composition and densities in different vegetation types. Some of it discusses the mechanisms which relate these densities to the habitat. If this information were compiled and generalized, it would provide a basis for predicting the impact on small mammal populations of contemplated land-use programs and possible small mammal management, either control or enhancement, through vegetation manipulation. There is considerable evidence that prey abundance is an important determinant of predator densities. Concern for predator conservation needs to consider abundance of prey species and the factors which affect it.

57558 Rodent management: the man/environment interface. Jackson, W.B. (Bowling Green State Univ., OH). pp 203-207 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Rodents which interact with man generally are regarded as undesirable. Attempts at eliminating such rodents by increasing predation (including traps, microbiological agents, toxicants) have been relatively unsuccessful. Management by environmental manipulation must be basic. This then can be supplemented with predation at critical points where public health, use practices, or imperfections in the system demand. Society mores, practices, and economic considerations also have significant impact on the management system.

57559 Small mammal populations in zoonotic disease and toxicological studies. Muul, I. (Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD). pp 208-223 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Examples of zoonotic diseases are discussed in relation to their distribution in mammalian hosts. Various ecological factors influence disease distribution patterns so that only a certain portion of the mammalian populations are subject to infections. Emphasis was placed on some of these ecological factors in studying the mainstream of infections in endemic hosts and vectors. This approach might be called medical ecology and would be supplemental to epidemiological studies which characteristically emphasize human involvement in zoonotic disease transmission. For example, occurrence in certain habitats and vertical distribution within forest habitats predisposed various mammalian species to infections. Arboreal species did not have scrub typhus infections while terrestrial species had high infection rates. Malaria parasites were common in arboreal mammals but uncommon in terrestrial species. Additionally, disease surveys in the absence of population data pertaining to potential host species sometimes yield misleading results, especially if age structure within populations changes through time. In field studies use of sentinel animals of known immunological history provide valuable supplemental information to surveys of free living animals which may have been infected at some unknown time in the past. As many different species should be studied as is practical since some species may not be susceptible to certain diseases under study. In laboratory studies, inclusion of non-standard mammals may provide opportunities to culture disease organisms which do not proliferate in standard laboratory species, or to replace diminishing resources of such species as primates.

57560 Responses of populations of small mammals to ionizing radiation. Kitchings, J.T. (Oak Ridge National Lab., TN). pp 224-230 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

Studies on the responses of small mammals to ionizing radiation have, over the past 30 years, documented numerous effects on direct mortality, reproduction, the hemopoietic systems, and radionuclide metabolism. Three general findings have resulted from past efforts: (1) ionizing radiation is a factor in environmental stress, (2) the response of wild small mammals to ionizing radiation is a mosaic of varying radiosensitivities interacting with environmental variables, and (3) one of the most sensitive organismal processes to radiation is reproduction. While an excellent understanding of the biological effects resulting from high or intermediate-level radiation exposures has been developed, this is not the case for effects of low-level doses (<1 rad/day).

57561 Concluding comments: from the worm's view, eco-pharmacodynamics and 2000 A.D. Barbehenn, K.R. (Environmental Protection Agency, Washington, DC). pp 231-237 of Populations of small mammals under natural conditions. Volume 5. Snyder, D.P. (ed.). Pittsburgh; Univ. of Pittsburgh (1978).

From Symposium on populations of small mammals under natural conditions; Linesville, PA, USA (14 May 1976).

There may be zoonoses to study (or avoid) in your own backyard but, in any event, a closer look at parasitic worms may shed some light on processes affecting mammalian populations. Here I offer some speculation with varying degrees of empirical and theoretical support. Endoparasites of mammals have different functional relationships with their hosts than do ectoparasites and insect parasitoids. Since death of the host usually terminates life for the endoparasite, some such parasites may have evolved mechanisms for preventing diseases in their hosts. Parasites may also promote apparent competitive exclusion among similar host species and a likely example is found among the flying squirrels in Eastern United States. Conceivably, parasites may mediate some predator-prey interactions but no examples are available. Adverse impacts of man-made organochlorine compounds, especially on predatory birds and mammals, have been documented, but the associated processes of bioconcentration, bioaccumulation, and biomagnification have not been clarified much beyond the stage of operational definitions.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 57525

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 56648, 57254, 57532, 57533, 57535, 57537, 57608

57562 (NUREG/CR—0158) **Soil, plant, food chain relationships of the transuranium elements. Selected annotated bibliography.** Wallace, A.; Romney, E.M.; Kinnear, J.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Jun 1978. 38p. (UCLA—12-1135). NTIS $4.50.

Approximately 260 annotated references to the literature on transuranium elements in soils and terrestrial ecosystems are presented. (HLW)

SOIL

REFER ALSO TO CITATION(S) 56645, 56662, 57536

57563 (LA—7311-PR) **Characteristics of wastes and soils which affect transport of radionuclides through the soil and their relationship to waste management. Progress report, July 1, 1976—September 30, 1977.** Fowler, E.B.; Polzer, W.L.; Essington, E.H. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 57p. (NUREG/CR—0125). Dep. NTIS, PC A04/MF A01.

Knowledge of the rate and degree of movement of radioactive nuclides through soil and geologic media is an important adjunct to the conduct of radioactive waste management. The Environmental Sciences Group of the Los Alamos Scientific Laboratory (LASL) is studying the interactions of various radioactive wastes with a wide variety of soils in order to establish a predictive range of radionuclide retention values to be used by the Nuclear Regulatory Commission (NRC) for the evaluation of waste handling, storage, and burial practices. This report covers field and laboratory efforts for the period July 1976 through September 1977. During that period, a total of five large-volume soil samples were classified and collected from the eastern, central and western United States. Two radioactive liquid wastes were also collected at LASL. Results of the laboratory studies on waste/soil interactions indicate that over the initial four-month period of waste storage no sorption of plutonium and only slight sorption of americium by soils occurred when they were interacted with a raw waste; about 50% of the soluble uranium was sorbed by the soils (the soluble fraction may contain particulates up to 0.05 μm in diameter). An increase in the concentration of radionuclides in the soluble fraction occurred with increased time of storage. In the case of the treated waste no increase in the concentration of plutonium was observed during the same time period. However, a change from no sorption to sorption by soils was observed for ^{238}Pu. The waste and waste/soil solutions were also characterized with respect to their chemical and physical properties.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 57534

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 56392, 57062, 57064

57564 (AD-A—051487) **Natural and man-induced soil pollution. Final report.** Mitchell, W.A.; Raabe, S.H. (Air Force Academy, CO (USA)). Nov 1977. 35p. (USAFA-TR—77-19). NTIS PC A03/MF A01.

Soil pollution is a form of pollution that is not as readily apparent as that found in air and water but can be just as noxious. Soil pollution should be considered in any efforts to ameliorate the misuse of the environment. This report examines various forms of both naturally and humanly induced soil pollution. (Author)

REGULATIONS

REFER ALSO TO CITATION(S) 57058, 57060, 57064

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 56538

BASIC STUDIES

REFER ALSO TO CITATION(S) 56646, 57061, 57062, 57520, 57570

57565 (BNL—24611) **Use of wetlands for treating wastes: wisdom in diversity.** Blumer, K. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 27p. (CONF-780368—1). Dep. NTIS, PC A03/MF A01.

From Symposium on freshwater wetlands; Tallahassee, FL, USA (2 Mar 1978).

Preliminary analysis of data from two Kissimmee Valley, Florida wetland models operating continuously over the past four years suggest that increased diversity may be one of the major factors in the startling ability of certain wetland systems to retain high amounts of nutrients. According to preliminary analysis of total phosphorus, increasing the number of biotopes, or ecocomponents, in a flow sequence will increase the ability of systems to take up and retain a greater amount of nutrients than would a continuous, single ecosystem of the same size. Increasing the number of compartments is, to begin with, an increase in structural diversity, and any biotic diversity is extended by the presence of different ecosystems adjacent to each other in linear sequence, thus providing habitat diversity. The increased number of barriers between ecocomponents increases the possibility for diversity by providing physical traps for nutrients and greater spatial heterogeneity. It is important to note that barriers may be distinct physical impediments to the movement of water, sediments or organisms between ecocomponents, such as a dam, or may be more subtle biological impediments, such as a gently sloping benthic gradient, which create slight habitat differences (water depth, light, temperature, etc.) favoring one plant or animal over another. The increase of habitat and species diversity as a means of improving nutrient uptake may provide a number of practical applications to recreating wetlands in the Kissimmee Valley. Implications of the findings for improving socio-economic conditions in the region are discussed.

57566 Preliminary investigations of the sublittoral macrofauna of Milford Haven. Addy, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 91-130 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Twenty-four sample stations on a variety of substrates were sampled in May 1974 in Milford Haven. 114 taxa were isolated, most of which were identified to species level. A preliminary particle size analysis of sediments at each station has been completed, enabling the approximate characterisation of sediment type at each station in terms of median particle size, phi quartile deviation and phi quartile skewness. A simple association analysis failed to indicate more than one grouping of stations. Little evidence has been found for the existence of classical benthic "communities" in Milford Haven. The data show a high degree of overlap in the distribution of different species. Proposals for a monitoring scheme for Milford Haven macrobenthos are discussed. It is recommended that at least ten samples per site be taken as a matter of routine. The areas most suitable for sampling regularly in an intensive way are thought to be Angle Bay, Dale Shelf and Dale Roads.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 56399, 56539, 56540, 56541, 56543, 56544, 56545, 56546, 56547, 56550, 56551, 56552, 56554, 56556, 56557, 56558, 56559, 56560, 56561, 56562, 56563, 56564, 56565, 56566, 57525, 57628, 57629, 57630, 57651

57567 (BNL—50787) **Data report: an assessment of the occurrence of human viruses in Long Island aquatic systems.** Vaughn, J.M.; Landry, E.F. (Brookhaven National Lab., Upton, NY (USA)). Dec 1977. Contract EY-76-C-02-0016. 143p. Dep. NTIS, PC A07/MF A01.

A virus survey was conducted in Nassau and Suffolk Counties under the auspices of the federally-funded "208" program from June 1976 to June 1977. The survey involved the concentration, enumeration, and identification of human enteroviruses from selected aquatic systems on Long Island including embayments, lakes, creeks, public drinking water supplies, groundwater influenced by wastewater recharge, sanitary landfills, and stormwater recharge basins; and the effluents from secondary and tertiary sewage treatment plants. Enteroviruses were isolated from all systems studied except the public water supply wells. As expected, viruses were most often encountered in the chlorinated effluents of sewage treatment plants. On two separate occasions, wild type Poliovirus was isolated from one of these plants. The limited sampling conducted at each site (1 per month) obviated any extensive interpretation of the data for the purpose of identifying the precise hazard posed by enteric viruses in Long Island waters. Among tentative conclusions were: support for the continued study of recharge of groundwater aquifers via the application of properly treated domestic wastewater to recharge basins; caution regarding placement of private septic systems in saturated zones near surface water bodies; the discharge of sewage effluents into embayments; and the identification of those areas requiring further virological study.

57568 (IS—4465) **Multilaboratory analytical quality control for the Hydrogeochemical and Stream Sediment Reconnaissance. Quality control report for June 1978.** D'Silva, A.P.; Floyd, M.A.; Haas, W.J. Jr. (Ames Lab., IA (USA)). 1978. Contract W-7405-ENG-82. 58p. Dep. NTIS, PC A04/MF A01.

Water standards were analyzed for uranium by isotope dilution mass spectrometry at the Oak Ridge National Laboratory and results are tabulated. Significant changes were made by LLL in the algorithm used to reduce data from the delayed neutron counter. Past results reported by LLL to the Ames Laboratory and reproduced in the Quality Assurance report for May 1978 were replaced by the revised values. Charts are presented to show statistics. (HLW)

57569 (PB—277088) **SAM/IA: a rapid screening method for environmental assessment of fossil energy process effluents. Final task report February—December 1977.** Schalit, L.M.; Wolfe, K.J. (Acurex Corp., Mountain View, CA (USA). Aerotherm Div.). Feb 1978. Contract EPA-68-02-2160. 168p. (AEROTHERM-TR—77-50). NTIS PC A08/MF A01.

The report describes the simplest member of a sequence of Source Analysis Models (SAMs) of increasing complexity and thoroughness which can be used as tools to help with one or more of five tasks involved in the environmental assessment of energy and industrial processes. The tasks are: (1) ranking individual effluent streams by the expected toxicity of their discharges; (2) establishing sampling priorities; (3) determining problem pollutants; (4) recommending best multimedia control technology alternatives; and (5) recommending control/disposal technology development programs. This model, SAM/IA, is useful for rapidly screening each effluent stream from a specific source: it is based on comparing effluent concentrations with the set of Minimum Acute Toxicity Effluent (MATE) criteria established by the EPA. The report explains the purposes of SAM/IA, the format used, and the MATE criteria against which pollutants are gauged. Several examples are included to illustrate specific facets of the model and of the format.

57570 (PNL-SA—6683) **Influence of organic matter on trace metal flux in coastal sediments.** Schmidt, R.L.; Gibson, C.I. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 15 May 1978. Contract EY-76-C-06-1830. 18p. (CONF-780682—1). Dep. NTIS, PC A02/MF A01.

From 41. meeting of the American Society of Limnology and Oceanography; Victoria, BC, Canada (19 Jun 1978).

These studies indicate that organic matter in coastal sediment constitutes a primary sink for trace metals, both at natural and amended levels. Organic substances are also involved in controlling the mobility and flux of trace metals from sediments. Further, organically-bound trace metals in sediments appear to be an important source to deposit-feeding organisms.

57571 (PNL-SA—6814) **Evaluation of alternatives for the removal/destruction of kepone residuals in the environment.** Dawson, G.W.; McNeese, J.A.; Christensen, D.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 15p. (CONF-780492—1). Dep. NTIS, PC A02/MF A01.

From Conference on control of hazardous material spills; Miami Beach, FL, USA (10 Apr 1978).

In February of 1977, the U.S. EPA initiated a feasibility study to evaluate the effectiveness, costs, and impacts associated with alternatives for removing and/or degrading Kepone in the James River, Virginia. The results of that work and their implications to other in-place toxic problems are discussed. Kepone from production discharges and bulk disposal of bad batches of product was released into the environment over the years between 1967 and mid-1975. During that time it is estimated that up to 200,000 lbs may have been discharged. It is further estimated that up to one quarter of that amount currently resides in the sediments of the James River. Ecological studies have indicated that nearly all of the tidal area of the James, over 70 miles, will require amelioration. Hence, if the impact of Kepone in the James River is to be eliminated, over 200 square miles of river bottom may require restoration. It is against this backdrop that the EPA feasibility study was conducted. The investigation covered biological, physical, and chemical alternatives for both restoration of the river and disposal of dredge spoils. The results of that work are summarized.

57572 **Marine ecology and oil pollution.** Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976). 573p. (CONF-7504140—). $60.00.

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Separate abstracts were prepared for the 20 papers presented at the conference. (HLW)

57573 **Environmental responsibility: industry.** Jagger, H. pp 5-8 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

The following topics are discussed: environmental legislation in Britain in regard to the oil industry; limitation of oil discharges from sea-going tankers; control of oil discharges in refineries and oil storage installations; development of monitoring techniques; atmospheric monitoring of sulfur dioxide; monitoring hydrocarbons, carbon monoxide, and nitrogen oxides in automotive emissions; and transportation of sulfur dioxide. (HLW)

57574 **Biological monitoring: principles, methods, and difficulties.** Baker, J.M. (Oil Pollution Research Unit, Pembroke, Wales). pp 41-53 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Biological monitoring is defined as the use of living organisms to determine the presence, amounts, changes in and effects of physical, chemical and biotic factors in the environment. Different approaches and methods for monitoring estuarine and coastal areas are covered: these include a discussion of different types of indicator organisms; and a description of the shore transect technique used in several monitoring programmes. An outline monitoring programme for a typical estuary is given.

57575 **Comparative toxicities of crude oils, refined oil products and oil emulsions.** Van Gelder-Ottway, S. pp 287-302 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

This paper describes toxicity texts carried out in the laboratory to determine the comparative toxicities of crude oils, refined oil products, and oil emulsions to several species of intertidal molluscs common on British rocky shores. Generally oil products with low boiling points appear to be more toxic than the heavier fuel oils while crude oils are intermediate with respect to toxicity. Heavier oils are, however, more of a physical hazard. There appears to be no simple relationship between, on the one hand the toxicity of mixtures of oil and dispersants, and on the other the toxicity of oil or dispersants alone. In the case of one widely used low toxicity dispersant, the oil and dispersant mixture was more toxic than either the crude oil or the dispersant.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 57254, 57532, 57533, 57535, 57537, 57568, 57608

57576 (CONF-780745—1) **Radionuclides in liquid effluents from Argonne National Laboratory: an example of monitoring for a multidisciplinary nuclear laboratory.** Sedlet, J.; Golchert, N.W. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From Conference on effluent and environmental radiation surveillance; Johnson, VT, USA (Jul 1978).

The environmental monitoring program conducted by Argonne National Laboratory for radionuclides in effluent and surface water is described and the results for the past six years are summarized. Small amounts of several radionuclides have been present in Argonne waste water, and are consequently detectable in the stream that receives this water. The most abundant of these is hydrogen-3, whose average concentration in the stream during this period was about 3000 pCi/l, equivalent to 0.1% of the drinking water standard. The distribution of plutonium and neptunium between stream water and particulate matter was studied. Plutonium tends to be relatively insoluble and become associated with the sediment, while most of the neptunium is in solution. This difference in behavior should be taken into account in designing environmental sampling and analytical programs and in dosimetric evaluation of effluent releases.

WATER

REFER ALSO TO CITATION(S) 56648, 56658, 57534

57577 (WaBoLu—38-77) **Comparative measurement to determine the radionuclide concentration in waste water from nuclear power plants.** Arndt, J.; Gans, I.; Ruehle, H.; Wolter, R. (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). Oct 1977. vp. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The comparative measurement has shown that for gamma emitters in the concentration range 10 to 100 pCi/ml (10^{-6} - 10^{-4} Ci/m^3), in which the concentration of radionuclides essentially contributing to the annual releases of nuclear power plants lies in many cases, a scatter of 5 - 10 pCi/ml for individual measured values. In about the same range lies the comparability of measured values from different laboratories. At lower concentrations, scattering range and comparability attain the size of the measured value. For the Sr isotopes in the concentration range 1 to 50 pCi/ml (1 x 10^{-6} - 5 x 10^{-5}Ci/m^3), a relative dispersion of about 30% and a corresponding comparability must be taken into account with concentrations above 0.02 pCi/ml (2 x 10^{-9} Ci/m^3), these values attain the level of the measured values. For tritium in the range of some 1,000 pCi/ml (10^{-3} Ci/m^3) there occurs a scatter of 400 pCi/ml (18%). At concentrations in the range of 50,000 pCi/ml (5 x 10^{-2}Ci/m^3) the relative scatter amounts to 12%.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 57604

57578 **Ecology of Aeromonas hydrophila in a South Carolina cooling reservoir.** Hazen, T.C. Winston-Salem, NC; Wake Forest University (1978). 277p. (SRO—900-4). Wake Forest Univ., Winston-Salem, NC.

Thesis.

The objectives of this study were: to measure the distribution and abundance of Aeromonas hydrophila in selected sites in a southeastern cooling reservoir while simultaneously monitoring a series of selected water quality parameters; to determine if the ecology of A. hydrophila is integral to the epizootiology of red-sore disease among the largemouth bass (Micropterus salmoides) population in the same reservoir; and to determine if the ecology of A. hydrophila is similar in other southeastern reservoirs and other parts of the United States. The primary study site was Par Pond, an 1012 ha cooling reservoir located on the Savannah River Plant (SRP) near Aiken, South Carolina. The impoundment receives heated effluent from a single nuclear production reactor.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 57064

REGULATIONS

REFER ALSO TO CITATION(S) 57064, 57573

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 56630

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 57091

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 57062, 57074, 57569

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 57539, 57540, 57541, 57542, 57543, 57544, 57545, 57546, 57547, 57548, 57549, 57550, 57551, 57552, 57553, 57554, 57555, 57556, 57557, 57558, 57619

57579 **Recovery and maintenance of live amphipods at a pressure of 580 bars from an ocean depth of 5700 meters.** Yayanos, A.A. (Univ. of California, San Diego). *Science;* **200**: No. 4345, 1056-1058(2 Jun 1978).

Amphipods were collected from an ocean depth of 5700 meters in a windowed pressure-retaining trap, kept alive in the trap for as long as 9 days aboard ship, and transported to a land laboratory. Observations suggest that the animals can easily tolerate decompressions of 29 percent and briefly of 70 percent of the value of 580 bars, the pressure of their natural habitat. The average pleopod beat frequency was 106 beats per minute. Evidence suggests that food (fish bait) can have at least a 4-day residence time in the gut of these animals.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 57595, 57602

57580 (CONF-780741—1) **Excited and ionic states of dimeric chlorophyll derivatives. Biomimetic modelling of the primary events of photosynthesis.** Wasielewski, M.R. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From Frontiers of biological energetics(electrons to tissues; Philadelphia, PA, USA (19 Jul 1978).

The following topics are discussed: preparation of covalently bound dimeric species of chlorophyll; molecular structure of bis(bacteriochlorophyllide a) ethylene glycol diester; ^{1}H spectra of BChl, a covalent dimer, dissolved in various solvents; chemical shift changes in proton resonances; C_2 symmetric folded configuration of covalently linked BChl; electronic transition spectrum of Chl a covalent dimer in dry CCl_4 and in water-saturated CCl_4; special pair models of bis(chlorophyll) cyclophanes; synthetic pathway for prep-

aration of bis(chlorophyll) cyclophane 8; proton magnetic resonance data; redox potentials of chlorophyll; and optical and EPR properties of special pairs. (HLW)

57581 (CONF-7806100—1) **Identification of atypical bile acids by gas chromatography-mass spectrometry-computer techniques.** Stellaard, F.; Szczepanik-Van Leeuwen, P.A. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From 5. symposium on mass spectrometer in biochemistry and medical; Rimini, Italy (19 Jun 1978).

These bile acids are rarely detected in human specimens although they supposedly play a role in the pathways. Trihydroxycoprostanic acid and varanic acid are intermediates in the cholic acid synthesis, while dihydroxycoprostanic acid appears in the chenodeoxycholic acid pathway. Since the oxidation and cleavage of the side chain is known to take place in the mitochondrial part of the liver cell, the results indicate that there is a correlation between the appearance of C_{27} bile acids and the mitochondrial defects. GC/MS/COMPUTER techniques have proven to be a powerful tool in the determination of bile acid compositions in liver disease and bile duct abnormalities. When atypical bile acids are present, the composition itself may have a diagnostic value in the determination of metabolic defects.

57582 Gene-sized pieces produced by digestion of linear duplex DNA with mung bean nuclease. Kroeker, W.D.; Kowalski, D. (Roswell Park Memorial Inst., Buffalo). *Biochemistry;* **17**: No. 16, 3236-3243(8 Aug 1978).

The single-strand specific endonuclease from mung bean sprouts catalyzes a limited number of doublestrand cleavages in linear duplex DNA from bacteriophages T_7, gh-1 and PM2. A molecular weight range of approximately 1.4 to 0.2 x 10^6 for the limit products derived from each DNA was estimated by agarose gel electrophoresis. The number of cleavages per T_7 DNA molecule at the digestion limit is 37 as determined by ^{32}P end labeling using polynucleotide kinase and [γ-^{32}P]-ATP. These cleavages are probably at unique sites, since discrete bands are seen after agarose gel electrophoresis of the products in the early stages of digestion of each DNA. Observation of discrete bands at the endonucleolytic limit is complicated by the terminally directed (exonuclease-like) activity of the enzyme and by a small number of random endonucleolytic cleavages. The unique sites are thermolabile. A 10°C increase in temperature results in a ca. tenfold increase in the initial hydrolysis rate of T_7DNA while the size distribution of the limit products is unchanged. Also, a change from 0.10 to 0.14 M salt concentration produces a ca. fourfold rate decrease. Double-strand cleavages in T_7DNA arise from the preferential cleavage opposite an enzyme-inflicted nick rather than by the accumulation of nicks at potential double-strand cleavage sites. The naturally occurring nicks in T_5DNA, which are in G + C rich sequences, are not preferred cleavage sites for mung bean nuclease unless they are first enlarged to five residue (average) gaps by Escherichia coli exonuclease III.

57583 Developmental regulation in cotton seed germination: polyadenylation of stored messenger RNA. Harris, B.; Dure, L. III. (Univ. of Georgia, Athens). *Biochemistry;* **17**: No. 16, 3250-3256(8 Aug 1978).

Evidence that RNA preexisting in the cotyledons of mature cotton seed (stored mRNA) is polyadenylated during the first day of germination is presented, based on three different experimental data sets. First, actinomycin D is found to inhibit $^{32}PO_4$ incorporation into mRNA-poly(A) by 62%, into mRNA by 70%, but into poly(A) only 30%. Second, far more $^{32}PO_4$ and [2-^{3}H]adenosine are incorporated into the poly(A) portion of mRNA-poly(A) than into the mRNA portion as would be expected from their relative sizes and base composition. This underlabeling of the mRNA moiety is enhanced when cotyledons are germinated in actinomycin D. However, an expected distribution of the isotopes between the mRNA and poly(A) moieties is found in cotyledons labeled later in germination. Third, spectral measurements of the absolute amount of mRNA-poly(A) accumulated during the first day of germination in cotyledons germinated in actinomycin D are larger than would be expected from the 70% inhibition of mRNA labeling caused by the drug. The three sets of data suggest that over 50% of the total mass of mRNA polyadenylated during early germination exists in the mature seed. Its complexity, however, has not been measured. These data may explain the sensitivity of much of germination enzyme synthesis to inhibition by 3'dAdo during early germination and its insensitivity to actinomycin D during this period.

57584 Transfer of Fv-1 locus-specific resistance to murine N-tropic and B-tropic retroviruses by cytoplasmic RNA. Yang, W.K. (Oak Ridge National Lab., TN); Tennant, R.W.; Rascati, R.J.; Otten, J.A.; Schluter, B.; Kiggans, J.O. Jr.; Myer, F.E.; Brown, A. *J. Virol.;* **27**: No. 2, 288-299(Aug 1978).

A standardized bioassay for transfer of Fv-1 gene-specific resistance to N-tropic and B-tropic murine retroviruses was developed using XC plaque reduction in SC-1 (Fv-1$^-$) cells inoculated with virus. Testing of subcellular fractions of restrictive cells showed that the resistance transfer activity was present in the cytoplasmic (microsomal and cytosol) fractions. The activity of the cytoplasmic extract was destroyed by treatment with ribonuclease, but not with deoxyribonuclease or proteases. RNA prepared by phenol-chloroform extraction of mouse tissues, including embryos and livers of weanling mice, transferred Fv-1 locus-specific resistance into DEAE-dextran-treated SC-1 cells. The activity of isolated RNA preparations against virus of the appropriate host-range type has been demonstrated to correspond to the Fv-1 genotypes of the cell sources. The specific transfer of resistance with cellular RNA was effective within a 5- to 6-h period from 2 h before to 4 to 5 h after virus infection. Sucrose gradient centrifugation of the RNA showed that the activity sedimented as a broad peak, with an apparent maximum in the 22S region. Affinity chromatography of whole-cell RNA on polyuridylic acid-Sepharose tended to separate more activity into the polyadenylic acid RNA fraction than the non-polyadenylic acid RNA fraction. Except for the reciprocal inhibitory activity for the two host-range virus types, the RNAs of Fv-1/sup n/ and Fv-1/sup b/ specificities showed similar properties in all aspects studied.

57585 Changes in hepatic levels of tyrosine aminotransferase messenger RNA during induction by hydrocortisone. Nickol, J.M.; Lee, K.L.; Kenney, F.T. (Univ. of Tennessee, Oak Ridge). *J. Biol. Chem.;* **253**: No. 11, 4009-4015(10 Jun 1978).

Messenger RNA specific for tyrosine aminotransferase was quantitated by microinjection into oocytes of Xenopus laevis. The heterologously translated enzyme was identified by specific immunoprecipitation and found to be identical with authentic aminotransferase by several criteria. The level of functional message present in rat liver increases during hydrocortisone induction, and this increase is directly proportional to the increased rate of synthesis of the enzyme. Kinetic analysis of the changes in tyrosine aminotransferase mRNA levels during induction and withdrawal indicates that the steroid does not affect the stability of the message, which has a half-life of approximately 1.2 h. Hydrocortisone, therefore, acts to increase the rate of synthesis of the specific messenger by stimulating either its transcription or processing to functional mRNA.

57586 Induction of endogenous murine retrovirus by hydroxyurea and related compounds. Rascati, R.J.; Tennant, R.W. (Oak Ridge National Lab., TN). *Virology;* **87**: No. 1, 208-211(1 Jun 1978).

Hydroxyurea and two related compounds, carbamoyloxyurea and formamidoxime, induce endogenous retrovirus expression in AKR mouse embryo cells. Only the induction of ecotropic (N-tropic).virus was detected. The ability of each compound to induce shows a linear dose-response over a limited range of concentrations which correlate with the cytotoxicity of each of the compounds. The data suggest that these compounds may induce virus expression via damage to cellular DNA.

57587 Coherent stimulated light emission (lasing) in covalently linked chlorophyll dimers. Hindman, J.C.; Kugel, R.; Wasielewski, M.R.; Katz, J.J. (Argonne National Lab., IL). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 5, 2076-2079(May 1978).

The covalently linked chlorophyll a dimer exhibits remarkably different properties in the folded and open configurations. In the folded configuration the absorption maximum is at 695 nm and the fluorescence maximum is at 730 nm. Laser output at 733 and 735 nm is obtained for solutions in wet benzene and 0.1 M ethanol/toluene, respectively. Measurements of fluorescence lineshapes, made with a transverse excited atmospheric (TEA) nitrogen laser for excitation, show the lifetime shortening associated with stimulated emission resulting from appreciable concentrations of molecules in S_1 excited states. In contrast, the open dimer has absorption and fluorescence spectra essentially the same as those of chlorophyll a monomer. Unlike either the folded dimer or chlorophyll a monomer, the open dimer shows no laser emission or fluorescence lifetime shortening. It does not appear that the behavior of the open dimer can be explained in terms of excimer or triplet formation or by nonradiative decay processes. It is suggested that absorption of the exciting radiation by S_1, leading to the formation of an exciplex or charge transfer state, may be involved. Significantly, no large changes in fluorescence quantum yield or fluorescence lifetime are observed for these dimers as compared to monomer chlorophyll. This suggests that concentration quenching and lifetime shortening in condensed chlorophyll systems involve more than the simple proximity of two chlorophyll molecules.

57588 Isolation of a low molecular weight Ca^{2+} carrier from calf heart inner mitochondrial membrane. Jeng, A.Y.; Ryan, T.E.; Shamoo, A.E. (Univ. of Rochester, NY). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 5, 2125-2129(May 1978).

A protein was isolated from calf heart inner mitochondrial membrane with the aid of an electron paramagnetic resonance assay based on the relative binding properties of Ca^{2+}, Mn^{2+}, and Mg^{2+} to

the protein. The molecular weight of this protein has been estimated to be about 3000 by urea/sodium dodecyl sulfate gel electrophoresis and amino acid analysis. The protein is shown to have two classes of binding sites for Ca^{2+} by flow dialysis studies and can extract Ca^{2+} into an organic phase. The selectivity sequence of this protein determined from the organic solvent extraction experiments shows that it favors divalent cations over monovalent cations. Also, the relative selectivity sequence for divalent cations is Ca^{2+}, $Sr^{2+} > Mn^{2+} > Mg^{2+}$. Ruthenium red and La^{3+} are shown to inhibit the protein-mediated extraction of Ca^{2+} into the organic solvent. The calcium translocation in a Pressman cell by this protein is selectively driven by a hydrogen ion gradient. Control experiments indicate that the Ca^{2+} transport properties of the protein are not due to the contaminating phospholipids. It appears that we have isolated from the inner mitochondrial membrane a calcium carrier, which we have named "calciphorin."

57589 Single-pulse picosecond determination of 735 nm fluorescence risetime in spinach chloroplasts. Campillo, A.J. (Los Alamos Scientific Lab., NM); Shapiro, S.L.; Geacintov, N.E.; Swenberg, C.E. *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **83**: No. 2, 316-320(Nov 1977).

Within the light harvesting and PS II antenna pigments which give-rise to the 685 nm emission, singlet exciton fusions do give rise to a strong decrease of the fluorescence lifetime with increasing intensity. It was concluded that the pigments which are responsible for the 735 nm emission derive their energy by singlet exciton transfer from the light harvesting system and not by direct photon absorption at 530 nm. In this paper we measure the risetime for the 735 nm emission and identify this time lag with the transfer rate from the light harvesting system to the PS I pigment molecules which give rise to the 735 nm fluorescence band at low temperatures.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 57283

CYTOLOGY

57590 (LA—7300-PR) **Development of a cell-analysis and sorting system applicable to tumor cell characterization and kinetic studies. Progress report, October 17, 1977—April 16, 1978.** Hoffman, R.A.; Salzman, G.C.; Britt, W.B. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

The radio-frequency (rf) impedance of a suspension of a single cell or cells depends upon the size, shape, and internal structure and composition of the cell. A flow-system instrument is described in which the passage of a partial or cell through a small (approximately 100 μm in diameter) orifice in a stream of saline produces a change in the complex rf impedance of the orifice. The impedance change is registered either as a change in amplitude and phase of an rf signal or equivalently as the change in in-phase and quadrature components of the signal. The first prototype of this instrument has detected phase and amplitude changes of test particles such as plastic spheres and mulberry pollen. We will report on the use of a refined version of this instrument for detecting mammalian cells and will discuss a method for classifying cells according to their rf impedance characteristics.

57591 (LA—7412-PR) **Automated cancer-cell sorting and analysis. Progress report, December 1, 1977—May 31, 1978.** Mullaney, P.F.; Steinkamp, J.A.; Salzman, G.C.; Crowell, J.M.; Svitra, Z.V.; Martin, J.C. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 40p. Dep. NTIS, PC A03/MF A01.

Major accomplishments have been in the areas of (1) development of a dual-laser system for cell analysis and sorting, and (2) exploration of a number of fluorochrome combinations suitable for excitation with the argon/krypton system. Work continues and will continue in the next program year on the development of staining protocols, first with model cell systems, for use with the dual-laser system. Any further work on light scattering will continue under separate funding, although the intention is to continue the Battelle Institute/Los Alamos Scientific Laboratory interaction.

57592 (LA-UR—78-1624) **Flow-system measurement of cell impedance properties.** Hoffman, R.A.; Britt, W.B. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 37p. (CONF-780488—3). Dep. NTIS, PC A03/MF A01.

From 6. conference on automated cytology; Elmau, F.R. Germany (23 Apr 1978).

A flow-system technique has been developed that detects the high-frequency resistance and capacitance changes in a sensing orifice due to the passage of cells through the orifice. The resistance and capacitance changes are related to cell properties such as size, plasma membrane capacitance, and electrical resistivity of the cell interior. The relationship between measured impedances and cellular properties is discussed, and the prototype instrument for making such measurements is described. The instrument can simultaneously detect the dc Coulter volume and two ac parameters related to the complex ac impedance change. Some initial tests of the instrument using plastic microspheres and Chinese hamster ovary cells are described.

57593 (ORO—2832-186) **Enzymatic induced unmasking of fetal antigens on normal murine hemopoietic stem cell surfaces.** Sheinberg, B.M. (Texas Univ., Houston (USA). Graduate School of Biomedical Sciences). Dec 1977. Contract EY-76-S-05-2832. 119p. Dep. NTIS, PC A06/MF A01.

Thesis.

Based upon information provided by indirect immunofluorescence and x-ray fluorescence, this investigation has demonstrated that fetal determinants are expressed upon the cell surface of adult cells, specifically; normal adult murine hemopoietic stem cells, derived from the bone marrow of BALB/c and C57 mice. This study has demonstrated that via enzymatic modification of the cell surface by collagenase followed by neuraminidase, these normal adult cells, which displayed no fetal determinants prior to enzyme treatment, have their membrane surface unmasked by some mechanism(s) and now express common fetal liver determinants. The specificity of these determinants is assayed through use of an antiserum which has been prepared against murine fetal liver (rabbit anti mouse fetal liver serum). These cells do not display these determinants when treated with neuraminidase followed by collagenase.

57594 (UCRL—80753) **Lead aspartate: a new en bloc stain for electron microscopy.** Walton, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-ENG-48. 4p. (CONF-780818—2). Dep. NTIS, PC A02/MF A01.

From Electron microscopy conference; Toronto, Canada (1 Aug 1978).

Lead aspartate has several advantages over lead citrate in that it can be used to stain tissues en bloc, prior to dehydration and embedding, and it is used at neutral pH. The high alkalinity required by lead citrate (pH 12) tends to leach out enzyme reaction products, making its use unsuitable for many cytochemical experiments. Lead aspartate staining is qualitatively similar to that by lead citrate but it is somewhat less intense. The resulting contrast is adequate for most electron microscopic study but, if desired, intensity can be increased by conventional grid counterstaining. The major advantages of lead aspartate stain are: en bloc staining is convenient and relatively contamination-free, it often permits bypass of the grid-staining step, and it can be used in conjunction with most cytochemical stains without obviously altering reaction products.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 57620, 57621, 57622

GENETICS

REFER ALSO TO CITATION(S) 57551

57595 (ORO—3982-48) **Eukaryotic transcription and processing: regulation of gene expression. Progress report, November 1, 1977—October 31, 1978.** Mans, R.J. (Florida Univ., Gainesville (USA). Dept. of Biochemistry and Molecular Biology). 1978. Contract EY-76-S-05-3982. 7p. Dep. NTIS, PC A02/MF A01.

We are attempting to prepare a cell-free protein synthesizing system from corn embryos that will translate mRNA's isolated from corn grain or transcribed from corn DNA by corn RNA polymerase II. The experience of others utilizing heterologous translation systems and isolated plant mRNA fractions suggests that the extent as well as the nature of the RNA sequences translated into peptide sequences may be influenced by components in the heterologous system. We wish to prepare a homologous system to compare with a heterologous system for detection and identification of potentially regulatory components required for in vitro polypeptide synthesis. The notion is that subtle differences in mRNA recognition by homologous versus heterologous components in the in vitro translation systems may be identified by comparison of the products accumulated by each system translating the same mRNA. Potentially the approach provides both an assay and a source of the putative "regulatory components." To this end we have undertaken: establishment of an active wheat germ translating system, reestablishment of the maize seedling amino acid incorporating system and its conversion to an S23 translator of endogeneous mRNAs, propagation of Barley Stripe Mosaic Virus in barley, isolation of its genome and resolution of the RNAs on a preparative scale, isolation of the poly A bearing RNA fraction from seedling and developing kernel systems, and isolation of the zein mRNAs from maize protein bodies.

57596 Genetic recombination and complementation between bacteriophage T7 and cloned fragments of T7 DNA. Campbell, J.L.; Richardson, C.C.; Studier, F.W. (Harvard Medical School, Boston). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 5, 2276-2280(May 1978).

Fragments of phage T7 DNA have been cloned in Escherichia coli by using the plasmid pMB9. Such cloned fragments are able to recombine with infecting phages, thus providing a means to integrate the physical and genetic maps of T7 DNA. Approximately 65% of the T7 DNA molecule has been found in clones so far, and analysis of these clones has mapped genes 12-17 with an accuracy of about 1% the total length of T7 DNA. At least some cloned segments can supply T7 functions to infecting phages.

57597 Action of mutagenic agents. Malling, H.V. (National Inst. of Environmental Health Sciences, Research Triangle Park, NC); Wassom, J.S. pp 99-152 of Handbook of teratology. Vol. I. Wilson, J.G.; Fraser, F.C. (eds.). New York; Plenum Publishing Corp. (1977).

The biochemical processes which ensure stability of genetic material transmitted from one generation to another are complex. A balance between fidelity and stability of genetic material enable organisms to proliferate in their environment. There is growing concern that chemicals which can interfere with genetic processes may contribute significantly to man's health burden by increasing the frequency of genetic diseases. This chapter reviews current knowledge about the mammalian gene and how mutations occur. A number of widely used compounds have been cataloged according to their mode of action and genetic effects. A listing of potentially mutagenic chemicals, their uses and/or applications in the environment. The structure and function of the Environmental Mutagen Information Center are described. The ensuing discussions concern: types of mutations (base-pair substitutions, frameshift mutations, small deletions, chromosomal abnormalities); general effects of mutations (types of effects—dominant lethals, point mutations, point mutations), consequences to society of increased mutation rate and comparison of mutation spectrum between ionizing radiation and chemicals; somatic mutations; influence of repair on mutagenesis; mutagenic agents; potential mutagens in the environment (agricultural chemicals, industrial compounds, food and feed additives, naturally occurring substances, drugs, pollutants, viruses, laboratory chemicals).

METABOLISM

REFER ALSO TO CITATION(S) 57585, 57626

57598 (COO—2066-30) **[Study of the mechanism of carcinogenesis by carcinogens which are negative in the Ames test]. Progress report, December 1, 1977—April 1, 1978.** Borek, E. (Colorado Univ., Denver (USA). Medical Center). 1978. Contract EY-76-S-02-2066. 6p. Dep. NTIS, PC A02/MF A01.

Progress is reported on the following studies: effects of ethionine on levels of progesterone in sera of male rats; and effects of thiourea and carbon tetrachloride on ovalbumin synthesis in oviduct of immature chick. (HLW)

MEDICINE

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 57487, 57488, 57489

57599 (NTIS/PS—78/0084) **Radioimmunoassay studies (a bibliography with abstracts). Report for 1964—February 1978.** Crockett, P.W. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 126p. NTIS PC N01/MF N01.

The bibliography presents a compilation of references on the application of the radioimmunoassay test to biochemistry, clinical chemistry, immunology, microbiology, and pharmacology. (This updated bibliography contains 121 abstracts, 21 of which are new entries to the previous edition.)

57600 Medical use of gallium radionuclides: a brief history with some comments. Hayes, R.L. (Oak Ridge Associated Universities, TN). *Semin. Nucl. Med.;* **8**: No. 3, 183-191(Jul 1978).

The use of gallium radionuclides in nuclear medicine dates back to the late 1940s, following the observation in toxicologic studies that gallium tended to localize to a high degree at sites of osteogenic activity. Initial attempts in the early 1950s to use ^{72}Ga for clinical diagnosis and therapy of malignant bone lesions were unproductive. However, the basic information gained then in the preclinical and clinical investigations was quite instrumental in generating the present-day use of gallium radionuclides as effective radiopharmaceutical agents. Although initial clinical trials of ^{72}Ga were unproductive, subsequent studies with ^{68}Ga and ^{67}Ga, together with advances in nuclear medical instrumentation, resulted in the identification of gallium radionuclides as effective tumor- and abscess-localizing agents. A major factor in the recognition of the peculiar biologic properties of gallium radionuclides was the existence of a carrier (stable isotope) effect. Also, it appears from basic studies of the mechanism(s) of the uptake of gallium in tumor tissue that the biodistribution of gallium involves many essential biologic processes. The future use of gallium radionuclides may, therefore, actually very well fall more into the field of basic biologic investigations rather than into the field of nuclear medical diagnosis.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 57567

57601 Use of waste liquor from bisulfite pulping to produce mixed culture single-cell protein. Lo, S.N. (Univ. of Quebec, Trois-Rivieres); Moreau, J.R.; St-Laurent, G. *Can. J. Chem. Eng.;* **56**: No. 1, 94-98(Feb 1978).

The activated sludge process might be used in the very near future to treat the waste liquors from small bisulfite mills in Canada, as a mean of controlling water pollution. These mills produce normally less than 300 t/d of pulp. It was found that the bio-sludge solids from such a process, when used to treat such waste liquor, contained approximately 38% protein, 47% carbohydrates, some vitamins and sufficient quantities of essential minerals. This biosubstance, a mixed-culture in nature, could be considered as a good source of single-cell protein. The nutritive value in terms of protein efficiency ratio of this substance was tested with rats; good results were obtained when the biomass was slightly supplemented with methionine. Described in this paper is a system used in our laboratory to produce this biomass in a sterile and dried form. The conversion of carbohydrates contained in waste pulping liquor to biomass was carried out in a 400-l, aerated, continuous-flow tank reactor. Under the operating conditions studied the sludge yield coefficient was 0.53 g of biomass/g of carbohydrates removed. A cash return study of selling biomass is also presented for two mills producing high- and low-yield pulps respectively.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 57553, 57611

57602 (LA-UR—78-1767) **Light collection and exciton dynamics in photosynthetic membranes.** Campillo, A.J.; Shapiro, S.L. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 11p. (CONF-780579—4). Dep. NTIS, PC A02/MF A01.

From Meeting on picosecond phenomena; Hilton Head, SC, USA (24 May 1978).

The structural organization for the light collection apparatus in higher plants is investigated by means of picosecond fluorescence spectroscopy. The exciton dynamics provide support for the tripartite model proposed by Kitajima and Butler.

TRACER TECHNIQUES

57603 Studies of the lymphatic drainage of dog lungs. Oberdoerster, G.; Gibb, F.R.; Beiter, H.; Lu, S.T.; Morrow, P.E. (Univ. of Rochester, NY). *J. Toxicol. Environ. Health;* **4**: No. 4, 571-586(Jul 1978).

The lymphatic system of the lungs has proved difficult to study and characterize because it is technically complex, its properties are difficult to quantitate, and anatomically it is extraordinarily variable. This study was part of a more comprehensive effort to understand the nature of lymphatic permeation by extrinsic materials (e.g., dusts) arising from alveolar deposition, and had three main objectives: (1) to develop a reliable surgical approach for the collection of lymph from the right duct; (2) to investigate some of the inconsistencies in lymphatic structure and function, especially the relationship of the right lymph duct (RLD) and thoracic lymph duct (TLD) outflows to the pulmonic lymph; and (3) to begin a systematic investigation of lymphatic uptake of administered materials by varying their physicochemical parameters. Ultimately, we utilized a modification of the surgical approach of Meyer, which we believe is less prone to blood contamination than the venous-sac procedure of Leeds and Uhley and provides purer pulmonic lymph. By this means we obtained average RLD flow rates of 4.5 ml/h or 0.35 ml/h body weight in 24 dogs, which are comparable to those in the recent literature. For demarcation of the pulmonic drainage in relation to the RLD and TLD, we found in 13 dogs that 75% or more of the lung lymph returned to the venous circulation through the RLD, whereas less than 3% of the thoracic lymph entered the RLD.

Radioactive tracers were administered by intralymphatic, intrabronchial, inhalation, and intravenous routes to obtain these findings and the uptake data. Lymphatic uptake values for iron, cadmium, and lead were obtained principally after intrabronchial administration. The uptake data, while preliminary, indicate that both the chemical species and their physical states are important in affecting alveolar permeation into the pulmonic lymph. Evidence for varying lymphatic roles in the alveolar retention of these heavy metals is also presented.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 57559, 57561, 57567

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 56462, 57055, 57095, 57565

57604 (CONF-780152—1) **Growth of monosex hybrid tilapia in the labortory and sewage oxidation ponds.** Suffern, J.S.; Adams, S.M.; Blaylock, B.G.; Coutant, C.C.; Guthrie, C.A. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From Meetings of the World Mariculture Society; Atlanta, GA, USA (3 Jan 1978).

Studies were conducted to evaluate the potential of monosex hybrid tilapia (female T. mossambica x male T. hornorum) in waste-heat polyculture systems. The optimum growth temperature for this hybrid was found to be 32°C in laboratory experiments. Experiments in sewage pond cage culture in the temperature range of 23 to 33°C at stocking densities of approximately 53 fish/m^3 were also conducted. At fish sizes between 5 and 12 cm TL, estimated annual production is approximately 50,000 kg/ha/yr (50,000 lb/acre/yr). Fish in the sewage oxidation ponds grew significantly faster than fish fed trout chow at optimum temperature in the laboratory, even though temperatures in the sewage ponds averaged below the optimum growth temperature. Techniques to accelerate growth rates are being explored. Exposure to gamma radiation (500 rads), known to cause significant increases in channel catfish growth rate, was found to have a similar effect on tilapia. After a 20-week growth period, exposed fish weighed an average of 20% more than controls.

BIOMEDICAL SCIENCES, APPLIED STUDIES

57605 (AD-A—051384) **Comprehensive Soviet encyclopedia (selected articles).** 22 Sep 1977. Translated by R.T. Creutz from pp 342, 344-346, 357, 376-377 of Bolshaya Sovetskaya Entsiklopediya, Third Edition (USSR), No. 3, 1970. (FTD-ID(RS)T—1527-77). 33p. NTIS PC A03/MF A01.

Contents: Biological Rhythms, Biological Cycles, Biological Effect of Ionizing Radiation; Bioluminescence, and Bioenergetics.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

57606 (ORO—3631-8) **Radiation damage and repair in cells and cell components. Progress report, November 1, 1977—October 31, 1978.** Fluke, D.J.; Pollard, E.C. (Duke Univ., Durham, NC (USA). Dept. of Zoology). 1978. Contract EY-76-S-05-3631. 69p. Dep. NTIS, PC A04/MF A01.

Progress is reported on the following research projects: coordinate induction of mutagenesis, radioresistance, and inhibition of post-radiation DNA degradation; radioinduced filamentation; action spectrum for induction of K12 lambda phage; effects of uv radiation on cells in the frozen state; dependence of mutagenesis on wavelength of uv; and w-reactivation of x-irradiated phage lambda. (HLW)

57607 **Deletions of the iso-1-cytochrome c and adjacent genes of yeast: discovery of the OSM1 gene controlling osmotic sensitivity.** Singh, A.; Sherman, F. (Univ. of Rochester, NY). *Genetics;* **89**: No. 4, 653-665(Aug 1978).

Some of the deletions in the yeast Saccharomyces cerevisiae that encompass the CYC1 gene, which determines iso-1-cytochrome c, extend into the OSM1 gene, causing inhibition of growth on hypertonic media, and into the RAD7 gene, causing sensitivity to uv light. Two deletions (cyc1-363 and cyc1-367) encompass only the CYC1 gene, two deletions (cyc1-366 and cyc1-368) encompass the CYC1 and OSM1 genes, three deletions (cyc1-1, cyc1-364 and cyc1-365) encompass the CYC1, OSM1 and RAD7 genes, while none of the deletions extend into the closely linked SUP4 gene.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 57307, 57534

57608 (ORNL—5420) **Industrial safety and applied health physics. Annual report for 1977.** Auxier, J.A.; Davis, D.M. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 103p. Dep. NTIS, PC A06/MF A01.

Progress is reported on the following: radiation monitoring with regard to personnel monitoring and health physics instrumentation; environs surveillance with regard to atmospheric monitoring, water monitoring, radiation background measurements, and soil and grass samples; radiation and safety surveys with regard to laboratory operations monitoring, radiation incidents, and laundry monitoring; industrial safety and special projects with regard to accident analysis, disabling injuries, and safety awards. (HLW)

57609 (ORNL/TM—6401/R1) **Nuclear accident dosimetry: calculations and comparison with experimental data.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

Calculated results, carried out by the method of discrete ordinates, of the absorbed dose received by personnel at various locations relative to the source in a simulated reactor criticality accident are presented and compared with experimental data. The geometry of the room in which the "accident" took place is included approximately in the calculations. The calculated and experimental data are in good agreement in all cases.

57610 **Studies of the mortality of A-bomb survivors. VI. Mortality and radiation dose, 1950—1974.** Beebe, G.W.; Kato, H.; Land, C.E. (Radiation Effects Research Foundation, Hiroshima). *Radiat. Res.;* **75**: No. 1, 138-201(Jul 1978).

Follow-up through 1974 adds 3402 deaths to the previously reported 16,828 among the 82,000 A-bomb survivors since 1950, 762 from cancer. With 14,405 deaths from natural causes other than cancer, there is still no real evidence that diseases other than cancer are involved in the late mortality effect of the nuclear radiation. In addition to leukemia and cancer of thyroid, breast, and lung, now cancer of the esophagus, stomach, and urinary organs, and the lymphomas, should be included among the forms of cancer caused by the ionizing radiation from the 1945 atomic explosions. Evidence of a general carcinogenic effect is increasing. Evidence of radiation carcinogenesis is much stronger for Hiroshima than for Nagasaki victims of the bombs. The leukemogenic effect still seems present in the 1970 to 1974 period, but greatly reduced, and the average absolute risk for other malignant neoplasms now exceeds that for leukemia. The minimal latent period for most of the carcinogenic effects was under 15 yr and depends on age and site of cancer. Age in 1945 plays an important but variable role in the carcinogenic effect, but one that cannot be fully understood without further observation. Only for leukemia in Himoshima are the data numerous enough to permit confident statements to be made about the form of the dose-response curve.

VERTEBRATES

REFER ALSO TO CITATION(S) 57539, 57560, 57604, 57617

57611 **Transfer of immunity by transfer of bone marrow cells: T-cell dependency.** Marusic, M. (Oak Ridge National Lab., TN). *Cell. Immunol.;* **38**: No. 2, 440-448(Jul 1978).

Thymectomized, lethally irradiated mice reconstituted with normal bone marrow cells succumbed when challenged ip with rat Yoshida ascites sarcoma (YAS) cells 40 days after irradiation and reconstitution. In contrast, thymectomized irradiated mice reconstituted with bone marrow cells from YAS-immune donors rejected the subsequent tumor challenge. Pretreatment of the bone marrow cells from immune donors with anti-Thy 1.2 antiserum and complement completely abolished the transfer of anti-YAS resistance. Bone marrow cells from donors thymectomized 2 months before immunization enabled almost all recipients to reject YAS, but bone marrow cells from donors thymectomized 8 months before immunization protected only 50 percent of the recipients. Further analysis showed that mice thymectomized 8 months before immunization failed to generate anti-YAS antibody response, whereas the antibody response

of mice thymectomized 2 months before immunization did not differ from that of non-thymectomized age-matched control mice. The data suggest that the immune reaction of mice against xenogeneic YAS requires long-lived T_2 lymphocytes.

57612 Spontaneous and radiation-induced benign tumors in parabiont rats. Warren, S.; Gates, O.; Brown, C.E.; Chute, R.N.; Porter, M.W. (New England Deaconess Hospital, Boston). *Radiat. Res.;* **75**: No. 1, 98-107(Jul 1978).

Spontaneous benign tumors are present in nearly half of NEDH rats. A single whole-body exposure of 1000 R X radiation delivered to a rat supported by a shielded parabiont partner induced high incidence rates of benign tumors in several radioresponsive organs: ovary, 49.7%; adrenal medulla (males, 23.9%; females, 15.2%); mammary tissue (females, 19.6%); islands of Langerhans (males, 15.3%); and liver (cholangiomas) (males, 7.4%; females, 13.8%). Both hormonal imbalance and radiation effects appear to be involved. Parabiosis decreased the incidence of pheochromocytoma, but irradiation of a partner increased it. Mammary tumors occurred on the average 200 days earlier in irradiated rats than in their unirradiated controls. Benign tumors rarely affected health. The incidence was not increased in most organs following irradiation. Three control series were used: single rats, control parabiont rats and the shielded partners of the irradiated partners. Although endometrial polyps were more frequent in irradiated than in shielded partners, they probably resulted from hormonal imbalance. Adenomas of the pituitary were most frequent in shielded female parabiont partners (16.0%). Their incidence was decreased by radiation to 4.2%. Most types of benign tumors rarely progress to malignancy.

57613 Metabolic and thermoregulatory effects of acute ^{60}Co radiation in myomorph rodents. Braham, H.W.; Sacher, G.A. (Ohio State Univ., Columbus). *Radiat. Res.;* **75**: No. 1, 108-120(Jul 1978).

The metabolic and thermoregulatory effects of sublethal ^{60}Co gamma radiation were studied in the white-footed mouse (Peromyscus leucopus) and the wild house mouse (Mus musculus). In both species of mice the ionizing radiation caused higher metabolic rates, excess heat loss to the environment, and 1 to 3°C lower body temperatures. Irradiated M. musculus experienced an 8% higher total metabolic rate than expected for controls, whereas irradiated P. leucopus registered a 20% higher total metabolic rate than expected. The effects of ionizing radiation were inversely proportional to activity; thermoregulation and metabolism were affected more when both species were at rest than when they were active. Irradiated P. leucopus became hyperthermic at an ambient temperature normally within thermoneutrality, and irradiated mice of both species became slightly hypothermic below thermoneutrality. Irradiated mice lost 25 to 30% more heat to the environment than controls. We suggest that blood circulation to peripheral tissues, or other hematological changes in irradiated mice, may bave occurred reducing the efficiency of thermal insulation.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 57532

57614 (LBL—7809) **Human disease from radon exposures: the impact of energy conservation in buildings.** Budnitz, R.J.; Berk, J.V.; Hollowell, C.D.; Nazaroff, W.W.; Nero, A.V.; Rosenfeld, A.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 8 Aug 1978. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

The level of radon and its daughters inside conventional buildings is often higher than the ambient background level. Interest in conserving energy is motivating home-owners and builders to reduce the rate of infiltration of fresh air into homes, and hence to increase the concentration of indoor air contaminants, including radon. It is unlikely, but possible, that the present radiation levels from radon daughters account for much of the lung cancer rate in non-smokers. In any event, it is likely that some increased lung cancer risk would result from increased radon exposures; hence, it is desirable not to allow radon concentrations to rise significantly. There are several ways to circumvent the increased risk without compromising energy conservation considerations.

ANIMALS

REFER ALSO TO CITATION(S) 57617

57615 Effects of chronic pulmonary irradiation on peripheral lymphocytes and their function in the dog. Benjamin, S.A.; Hahn, F.F.; Boecker, B.B. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Radiat. Res.;* **75**: No. 1, 121-137(Jul 1978).

Beagle dogs were exposed by inhalation to ^{144}Ce in fused aluminosilicate particles, a relatively insoluble, inert carrier material. The radioactive particles deposited in the deep lung resulted in chronic irradiation of the pulmonary and adjacent thoracic tissues. Dogs exposed to high levels of ^{144}Ce in fused aluminosilicate particles received more than 25,000 rad to lung by 3 yr after exposure. They developed a severe and persistent lymphopenia, and their remaining peripheral lymphocytes showed a decreased ability to respond to plant mitogens in vitro. The lymphopenia and the functional defect in the remaining lymphocytes suggested that an immunologic suppression existed in these dogs. Many lymphocytes were being killed in vivo by the radiation but another population was present that was viable in vivo but died when placed in vitro, accounting for at least part of the reduction in response to plant mitogens. No plasma factor was found that could account for the reduced lymphocyte transformation. The ^{144}Ce-exposed dogs developed a high incidence of primary pulmonary hemangiosarcomas between 1 and 5 yr after exposure. This suggests that carcinogenesis after intrapulmonary deposition of radionuclides may result from a combination of the direct carcinogenic effect and the immunosuppressive effect of the irradiation.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

57616 (Y/DD—225) **Sixteen years of uranium personnel monitoring experience in retrospect.** West, C.M.; Scott, L.M.; Schultz, N.B. (Oak Ridge Y-12 Plant, TN (USA)). 1977. Contract W-7405-ENG-26. 15p. (CONF-770720—15). Dep. NTIS, PC A02/MF A01.

From 22. annual meeting of the Health Physics Society; Atlanta, GA, USA (3 Jul 1977).

Since 1961, at the Oak Ridge Y-12 Plant, operated by UCC-ND for the United States Department of Energy, about 2200 employees per year have been routinely monitored by bioassay and in vivo techniques for internal exposure to uranium. In order to help control exposures, 49 of those employees (upon showing elevated results in either of the monitoring programs) were restricted from working with uranium for periods of six months or longer. A summary of the monitoring experience on these employees during the periods of removal is presented, and typical or illustrative cases are discussed. Four previously reported anomalous cases in which the monitoring results remained elevated for more than four years are reviewed and brought up to date. It is demonstrated that the removal of employees from uranium work generally results in a quick return of their monitoring results to minimal levels.

ANIMALS

REFER ALSO TO CITATION(S) 57560, 57603

57617 (PB—276819) **Evaluation of neonate squirrel monkeys receiving tritiated water throughout gestation.** Jones, D.C.L. (Stanford Research Inst., Menlo Park, CA (USA)). Jan 1978. Contract EPA-68-02-2280. 68p. NTIS PC A04/MF A01.

The effect of receiving tritiated water (HTO) throughout gestation on the developing primate was assessed by administering HTO to adult female squirrel monkeys (Saimiri sciureus) as the only source of drinking water beginning with the day of insemination and continuing throughout pregnancy. For the control (tap water) and six experimental groups, the mean urinary tritium concentrations in females delivering full-term progeny were <0.004, 0.05, 0.16, 0.33, 0.75, 1.61, and 3.09 microcuries/ml. Positive bioassays for pregnancy were observed in about half of 277 inseminated females. Among pregnant females, the full-term delivery rate was 36%, the abortion rate was 7%, and the resorption rate was 58% with no discernible effect of HTO administration on any of these parameters. The 46 full-term progeny were evaluated within 2 days of birth. No effects of HTO administration were observed in terms of gestation period (median 153 days, range 141-158 days), sex distribution, body weight, body dimensions, selected organ weights, histology (except gonads), or hematologic pattern. The number of primary oocytes in female progeny decreased markedly within increasing concentrations of tritium. Specific quantification of this effect and evaluation of the neonate testes is in progress.

PLANTS

57618 (BNWL-SA—6314) **Plant uptake of americium, curium, and the chemical analog neodymium.** Weimer, W.C.; Laul, J.C.; Kutt, J.C.; Bondietti, E.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract EY-76-C-06-1830. 11p. (CONF-771072—8). Dep. NTIS, PC A02/MF A01.

From 3. international conference on nuclear methods in environmental and energy research; Columbia, MO, USA (10 Oct 1977).

The plant uptake from several bulk soils has been determined for neodymium, a chemical analog to the transuranium elements americium and curium, and several other native rare earth elements as well. These investigations have demonstrated that neodymium, which has very similar chemical properties to americium and curium and should have a similar environmental behavior, does behave indistinguishably under both laboratory and field conditions. The uptake of the weathered or mobile forms of these elements from soils is expected to be governed primarily by their identical oxidation states and nearly identical ionic radii. This hypothesis is strongly supported by the chondritic (primordial) normalized rare earth element patterns in several plants. In these samples, the entire series of rare earth elements behaves as a smooth function of the REE ionic radii, as is also seen in the contiguous soils. This behavior suggests that the plant uptake of other ions with similar chemical properties (i.e., americium and curium) would also be governed by ionic size and charge.

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 57063

CELLS

REFER ALSO TO CITATION(S) 57578

VERTEBRATES

REFER ALSO TO CITATION(S) 57578, 57604

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 57091

57619 Importance of behavioural patterns in toxicity testing and ecological prediction. Dicks, B. (Oil Pollution Research Unit, Pembroke, Wales). pp 303-319 of Marine ecology and oil pollution. Baker, J.M. (ed.). New York; John Wiley and Sons Inc. (1976).

From Meeting of the Institute of Petroleum/field studies council; Aviemore, UK (21 Apr 1975).

Many toxicity tests for oil pollutants rely on mortality of a test organism, both for ranking compounds in order of toxicity and for making ecological predictions. These tests often do not take into account two important aspects of animal behaviour which can substantially influence the effect of a pollutant on an organism. These are that changes in behaviour in response to sub-lethal doses of pollutant may have far-reaching ecological effects, and that natural rhythm in an animal's activity may substantially influence its susceptibility to pollutants. Examples are described which illustrate these points. The first involves a study of settlement of an acorn barnacle, Balanus balanoides, around a refinery effluent outfall, and a study of some effluent effects on a larval stage of this species. The second concerns the responses of the limpet, Patella vulgata, to crude oil. Also included are notes on escape reactions of Nereis diversicolor produced by sub-lethal doses of refinery effluent, and the reaction of Littorina saxatilis to a sub-lethal dose of refinery effluent.

CELLS

57620 Cellular and molecular toxicology of lead. I. Effect of lead on cultured cell proliferation. Kusell, M.; O'Cheskey, S.; Gerschenson, L.E. (Univ. of California, Los Angeles). *J. Toxicol. Environ. Health;* **4**: No. 4, 503-513(Jul 1978).

Growth studies were done on a cultured rat liver cell line (RLC-GAI) grown in a chemically defined medium in the presence of lead nitrate. Lead reversibly inhibited the growth of these cells even after 6 d of exposure to the heavy metal. To compare lead sensitivity in various cell lines, G150 and LD50 values were determined in the RLC-GAI cells as well as two glioma cell lines (B82 and C_6) and a neuroblastoma cell line (N18). The LD50 values paralleled but were consistently lower than the G150 values. Since lead is known to affect heme synthesis, hemin was added to test the possibility of preventing the growth-inhibitory effect of the lead. The growth capacity of lead-treated cells did not change with the addition of hemin. It is thought that differential cultured cell lines such as these could be useful in examining the molecular mechanism of lead toxicity.

57621 Cellular and molecular toxicology of lead. II. Effect of lead on δ-aminolevulinic acid synthetase of cultured cells. Kusell, M.; Lake, L.; Andersson, M.; Gerschenson, L.E. (Univ. of California, Los Angeles). *J. Toxicol. Environ. Health;* **4**: No. 4, 515-525(Jul 1978).

The effect of lead nitrate on delta-aminolevulinic acid synthetase (ALA synthetase), the first and rate-limiting enzyme of the heme biosynthetic pathway, was studied by using an established rat liver cell line (RLC-GAI). Lead was shown to produce a time-dependent increase in ALA synthetase activity, with a maximum after incubation of the cells for 24 h with 10^{-5} M lead nitrate. The effect of lead was not liver-specific in that increases in enzyme activity were produced in other tissue-derived cell lines. Cycloheximide but not actinomycin D, cordycepin, or hydroxyurea, at concentrations that inhibit the synthesis of protein, RNA, and DNA, prevented the lead-associated increase in ALA synthetase activity. Heme, added to the cells as hemin, also prevented the effect of lead. These results indicate that lead induced the synthesis of ALA synthetase secondary to an inhibition of the synthesis of heme.

57622 Cellular and molecular toxicology of lead. III. Effect of lead on heme synthesis. Lake, L.; Gerschenson, L.E. (Univ. of California, Los Angeles). *J. Toxicol. Environ. Health;* **4**: No. 4, 527-540(Jul 1978).

The effect of lead nitrate on the biosynthesis of heme and the cellular uptake of ^{59}Fe was studied in an established rat liver cell line (RLC-GAI) grown in serum-free medium. Heme synthesis was shown to be increased in lead-treated cells when determined by measuring the amount of ^{59}Fe incorporated into the heme fraction of cell homogenates; concomitant with increased ^{59}Fe incorporation into heme, cellular uptake of ^{59}Fe was also increased. By contrast, heme synthesis was inhibited by lead in a dose-dependent manner when determined by measuring the conversion of [^{14}C]aminolevulinic acid into heme under identical experimental conditions. Cellular degradation of heme was not found to be significantly affected by lead. It is proposed that lead inhibited the biosynthesis of heme and that the increased incorporation of ^{59}Fe into the heme fraction of the lead-treated cells was the result of the increased uptake of ^{59}Fe and hence labeling of the heme molecules. Evidence is presented that suggests that only ^{59}Fe present in solution as a low-molecular-weight complex was accumulated in increased amounts by lead-treated cells.

57623 Epidermal growth factor; relationship between receptor regulation and mitogenesis in 3T3 cells. Aharonov, A.; Pruss, R.M.; Herschman, H.R. (Univ. of California, Los Angeles). *J. Biol. Chem.;* **253**: No. 11, 3970-3977(10 Jun 1978).

Exposure of confluent nondividing 3T3 cells to 10 nm mouse epidermal growth factor (EGF) at 37°, followed by incubation for 4.5 h at 37°, leads to a 70 to 85% reduction in the binding capacity for ^{125}I-EGF. Scatchard analysis of the binding data indicate that the reduction of ^{125}I-EGF binding is due to a decrease in the number of available EGF-receptors per cell, without any change in the affinity of the receptors for EGF. This modulation of the EGF-receptor by the growth factor, termed "down regulation," is dependent on temperature, EGF concentration, time, and the physiological state of the cell. Receptor loss occurs at physiological EGF concentrations (0.1 to 10 nm) which span the concentration range which is mitogenic for 3T3 cells. Maximal stimulation of either [^{3}H]thymidine uptake or cell division occurs at 1 nm EGF, a concentration at which only 20% of the EGF-receptor sites are occupied and down regulation is only 55% complete. Low EGF concentrations (< or = to 1 nm) result in down regulation of unoccupied EGF-receptors. Down regulation of the EGF-receptor also occurs in SV 40-transformed 3T3 cells. Growing 3T3 cells exposed to EGF also loose available EGF-receptors. In contrast to confluent cells, dividing 3T3 cells rapidly replace EGF-receptors on the surface of the cell, in the presence of EGF.

MICROORGANISMS

REFER ALSO TO CITATION(S) 57522

PLANTS

REFER ALSO TO CITATION(S) 57522

INVERTEBRATES

REFER ALSO TO CITATION(S) 56557

VERTEBRATES

REFER ALSO TO CITATION(S) 57603

57624 (COO—3139-31) **Embryo culture in teratological surveillance and serum proteins in development. Progress report, 1977—1978.** Klein, N.W. (Connecticut Univ., Storrs (USA). Dept. of Animal Genetics). Jul 1978. Contract EY-76-S-02-3139. 10p. Dep. NTIS, PC A02/MF A01.

Studies were conducted on two established teratogens, cadmium and cyclophosphamide, and four substances related to energy technology, coal solid, spent shale particulates, shale oil, and coal oil. Rat embryos were cultured on serum from animals injected with teratogens. Studies were also conducted on regulation of serum protein synthesis using endoderm cell cultures from chick embryos and cell-free synthesis of serum proteins. (HLW)

57625 (LA—7370-MS) **Preliminary toxicological study of Sylgard 184 encapsulating resin: curing agent.** Smith, D.M.; Drake, G.A.; London, J.E.; Thomas, R.G. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 5p. Dep. NTIS, PC A02/MF A01.

The acute oral LD_{50}[30] values for Sylgard 184 (100 parts encapsulating resin plus 10 parts curing agent) were greater than 5 g/kg in rats and mice. According to classical guidelines, the mixture would be considered slightly toxic or practically nontoxic in both species. Skin application studies in the rabbit demonstrated the mixture to be mildly irritating. Eye irritation tests, also in the rabbit, showed the Sylgard 184 mixture to be a mild but transitory irritant. The sensitization study in the guinea pig demonstrated the mixture to be a very mild sensitizer in two of six animals.

MAN

57626 **Bone storage and release.** Smith, F.A.; Hursh, J.B. (Univ. of Rochester, NY). pp 469-482 of Handbook of physiology-reactions to environmental agents. Baltimore; Williams and Wilkins (1977).

Both of the elements chosen for review occur naturally in the human environment. Damage to the ambient air quality from fluoride is more likely to be located in areas adjacent to and downwind from the various sources, whereas that from lead may be more widespread—wherever the automobile goes. In areas remote from man's activities, airborne concentrations of both agents are of the same order of magnitude, namely, 0.05 $\mu g/m^3$ or less. However, man's impact on his surroundings raises these levels appreciably, as much as 40-fold for fluoride and 50- to 150-fold for lead. The relative increases are great, of course, but, nevertheless, the principal source of intake for both elements is not from the air, but from the diet. Lead is obtained almost entirely from food, with very little coming from drinking water. Most water supplies used in the United States contain less than 50 μg Pb/l, but many may contain 5—6 mg F/l, or, in a few instances, more. The appreciably greater intake from this source readily explains why the body burden of fluoride is so much greater than that of lead. Major features in the metabolism of the two elements are enumerated in Table 5. They share several features in common, but a significant difference is the rapid and nearly quantitative uptake of lead by the erythrocytes. In this manner the individual is afforded appreciable protection against the acutely toxic effects of absorbed lead. A buffering action against acute fluoride toxicity is achieved by the rapid removal of the greater part of absorbed fluoride directly to the bone, most of the remainder being rapidly excreted in the urine. Both elements are removed from the bone by osteoclastic activity, and both require a significantly long time, of the order of 8—10 yr, for a turnover of half the skeletal burden.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

57627 (AD-A—051218) **The physical basis of electromagnetic interactions with biological systems.** Taylor, L.S.; Cheung, A.Y. (Maryland Univ., College Park (USA)). 17 Jun 1977. Contract N00014-77-C-0261. 395p.

The wide application of industrial, commercial and military devices and systems which radiate frequencies in the radiofrequency and microwave portion of the electromagnetic spectrum plus numerous only partially understood indications of microwave effects upon living organisms have raised important questions of the physical basis of the interactions of electromagnetic fields with biological systems. These questions must be answered if the development of regulatory standards and of methods and techniques for controlling radiofrequency and microwave exposure is to be achieved. The same questions must be answered in connection with present and proposed therapeutic applications of these waves. The rapid increase in the use of these frequencies makes these questions matters of imperative concern, particularly in view of the possibilities of cumulative or delayed effects of exposure. The purpose of the Workshop on the Physical Basis of Electromagnetic Interactions with Biological Systems was to bring together the leading investigators in the field to present the results of recent research, to determine the present status of the field and the priority of significant problem areas, and to critically evaluate conflicting theoretical interpretations and experimental techniques.

HEALTH AND SAFETY

57628 (AD-A—049805) **SS Sansinena (Liberian); explosion and fire in Los Angeles Harbor, California on 17 December 1976 with loss of life. Marine casualty report.** (Coast Guard, Washington, DC (USA)). 25 Nov 1977. 54p. (USCG—16732/71895). NTIS PC A04/MF A01.

On 17 December 1976 the Liberian tanker SANSINENA, moored at berth 46, Union Oil Terminal, Los Angeles Harbor, California, exploded and burned while taking on ballast and bunkers. The casualty resulted in six members of the SANSINENA's crew known dead, and 22 injured. Two crewmembers and one terminal security guard are missing and presumed dead. Also approximately 36 personal injuries were suffered by the general public. This report contains the U.S. Coast Guard Marine Board of Investigation report and the Action taken by the Commandant to determine the probable cause of the casualty and the recommendations to prevent recurrence. The Commandant concurred with the Marine Board that the probable cause of the casualty was the ignition of a hydrocarbon vapor cloud over the afterdeck of the SANSINENA. The source of ignition cannot be positively identified; however, it was most probably located in the vicinity of the midship deckhouse.

57629 (AD-A—049807) **SS Edgar M. Queeny collision with the Liberian S/T Corinthos, Marcus Hook, Pennsylvania, 31 January 1975. Marine casualty report.** (Coast Guard, Washington, DC (USA)). 27 Oct 1977. 55p. (USCG/NTSB-MAR—77-2). NTIS PC A04/MF A01.

At 0029, on January 31, 1975, the U.S. Registered tankship SS EDGAR M. QUEENY, laden with chemical and petroleum products, was maneuvering into Marcus Hook channel of the Delaware River in Pennsylvania, when it collided with the Liberian tanker S/T CORINTHOS which was moored and discharging a bulk cargo of crude oil at the British Petroleum Company dock. The port anchor of the QUEENY slightly penetrated the port side plating of the CORINTHOS at an angle of about 39 deg. into one or more of the wing cargo tanks, which were being pumped and were approximately half full. Almost immediately, a series of increasingly intense explosions began in the CORINTHOS, and the vessel was engulfed in flames. Twenty-six persons were killed or are missing and 11 were injured in this accident. The QUEENY suffered minor damage but the CORINTHOS was destroyed. The Delaware River was polluted by oil about Marcus Hook. Property damage was estimated to be $20 million.

57630 (AD-A—049845) **M/V Elias explosion and fire at Fort Mifflin, Pa., on 9 April 1974 with loss of life. Marine casualty report.** (Coast Guard, Washington, DC (USA)). 9 Sep 1977. 43p. (USCG—16732/51363). NTIS PC A03/MF A01.

At approximately 10 P.M. on 9 April 1974 while the M/V ELIAS was in the process of completing the discharge of a full cargo of Bachaquero crude oil at the Atlantic Richfield Oil (ARCO) Terminal, Fort Mifflin, Pennsylvania on the Delaware River the vessel sustained a series of three massive explosions, burned and sank. Nine members of the crew and four visitors (relatives of the master) perished or are missing. The M/V ELIAS was a total loss and the SS EDWARD L. STEINGER and the ARCO Terminal sustained extensive damages. The report contains the U.S. Coast Guard Marine Board of Investigation report and the Action taken by the Commandant to determine the probable cause of the casualty and the recommendations to prevent recurrence. The Commandant concurred with the Marine Board that source, and location of the initial explosion cannot be determined. Evidence of internal explosion in the after pump room, the cofferdam in the number 3 starboard cargo tanks, and in several of the cargo tanks indicate a varied path of the explosions.

57631 (IS-EMRRI—8) **Grain elevator explosions: a university view.** Bluhm, D.D. (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 1978. Contract W-7405-ENG-82. 27p. (CONF-780731—1). Dep. NTIS, PC A03/MF A01.

From Symposium on grain elevator explosions; Washington, DC, USA (11 Jul 1978).

Grain dust is a very hazardous material if not properly controlled. It can be a fire and explosion hazard as well as a health hazard. One of the most timely and effective methods to reduce the grain dust explosion is to apply all known prevention and control techniques. These techniques must be universally employed throughout the industry. The final recommendations necessary to prevent and control grain dust explosions and fires in grain elevators and feed mills are: improve the design of new elevators and feed mills based on current research and development results reflecting increased fire and explosion safety; determine the most economical methods of retrofitting the existing facilities; establish a National Information Center to make available more accurate and up to date

information; and perform comprehensive analysis of future fires and explosions in grain handling facilities.

57632 (UCRL—81366) **MORT at Lawrence Livermore Laboratory.** Toy, A.J.; Mackanic, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 3p. (CONF-780679—4). Dep. NTIS, PC A02/MF A01.

From JOPWOG-6/SubWOG-268 meeting; Albuquerque, NM, USA (27 Jun 1978).

LLL is usng many of the MORT techniques and principles. Most of the facets in general use predate MORT. We realize that maintaining the status quo is not sufficient so we are trying out new MORT techniques to improve our safety performance. It is also clear that MORT is not self-implementing. A concerted effort is required to change from techniques which have worked adequately.

57633 Mathematical models of age and ultraviolet effects on the incidence of skin cancer among whites in the United States. Fears, T.R.; Scotto, J.; Schneiderman, M.A. (National Cancer Inst., Bethesda, MD). *Am. J. Epidemiol.;* **105**: No. 5, 420-427(May 1977).

That sunlight leads to skin cancer has been generally accepted for nearly a century. Physical data are, for the first time, available which support this hypothesis. The authors have found that a simple power relationship can be used to describe the data and that the form of this power function suggests that the risk of nonmelanoma skin cancer is related to cumulative lifetime ultraviolet (UV) exposure and that the risk of melanoma skin cancer is related to annual UV exposure. The authors emphasize that skin cancer risk also depends on location-specific demographic variables other than ultraviolet radiation.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 57639

GEOPHYSICS

57634 Suggestion of a eutectic region between the liquid and solid core of the earth. Alder, B.J.; Trigueros, M. (Univ. of California, Livermore). *J. Geophys. Res.;* **82**: No. 17, 2535-2539(10 Jun 1977).

The observed small dependence of the sound speed with pressure just outside the solid inner core of the earth can be reasonably explained if the pressure and temperature conditions before solidification are such that the liquidus of a eutectic phase diagram is followed. The model is that upon crossing the eutectic as the core is approached, the denser solid iron phase would settle out in the gravitational field and the concentration of the other elements in the remaining liquid would increase rapidly. It is shown for either sulfur or silicon as the light element that the concentration change required to explain the small variation in sound speed is comparable to that for the known liquidus under normal conditions. The predicted density change along the liquidus is very small and may lead to hydrodynamic instabilities in that region.

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 56479, 56504

57635 (SAND—77-0673) **Stresses and strains developed by the reflection of seismic waves at a free surface.** Banister, J.R.; Ellett, D.M.; Mehl, C.R.; Dean, F.F. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 31p. Dep. NTIS, PC A03/MF A01.

Exact and approximate equations have been derived for the stresses and strains beneath a free surface when an incoming longitudinal wave and an incoming shear wave reflect from the surface. Results of the approximate solution for depths much less than the wave length of the incoming wave are given in tabular form and are graphed for Poisson's ratios of 0.25, 0.3, and 0.333. The results should be of use in categorizing the magnitude of near-surface stresses and strains resulting from seismic waves produced by deeply buried explosives or earthquakes.

57636 Velocity anomalies in dilatant rock. Scholz, C.H. (Lamont-Doherty Geological Observatory, Palisades, NY). *Science;* **201**: No. 4354, 441-442(4 Aug 1978).

Seismic velocities measured in rock deformed in the laboratory show excellent agreement with theoretical predictions of the effects of crack growth during dilatancy. Under appropriate conditions dilatancy was observed to produce a drop in the ratio of the seismic compressional velocity to the seismic shear velocity both by the mechanism of undersaturation and by a liquid-gas phase transition.

57637 Trench-volcano gap along the Alaska-Aleutian arc: facts and speculations on the role of terrigenous sediments for subduction. Jacob, K.H.; Nakamura, K.; Davies, J.H. (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, NY). pp 243-258 of Island arcs, deep sea trenches, and back-arc basins. Washington, DC; American Geophysical Union (1977).

Spatial variations in the present tectonic style are observed along the Alaska-Aleutian arc: changes in dip and maximum depth of the Benioff zone, widening of the trench-volcano gap, progression from oblique to normal subduction in the western and central Aleutians to almost continental collision in the Gulf of Alaska. The trench-volcano gap is 170 km wide in the central Aleutians, 300 km wide at the Alaska Peninsula, and 570 km wide in the Gulf of Alaska/Cook Inlet/Mt. McKinley region. Widening of the trench-volcano gap and related changes in dip of the Benioff zone correlate in the Gulf of Alaska with supply of large amounts of terrigenous sediments to the subduction zone. The unusual width of the gap, associated with a shallow dip of the subducted plate, may be generated by at least two mechanisms: sedimentary accretion and sediment-induced inhibition of subduction. Possible reasons for the initial shallow dip of the Pacific plate include: (1) Inhibition of subduction by incorporating low-density terrigenous sediments into the descending dense oceanic lithosphere. (2) Suction between the buoyant continental overthrusting wedge and the sinking oceanic plate. Reasons (1) and (2) apply only at shallow depths (less than 100 km). At larger depths (greater than 100 km), thermally induced density differences between the subducted plate and the surrounding mantle, and mantle mobility maintained by convective heat from the asthenosphere may be more important factors controlling the dip of subducted plates. From this local study it appears that abundant sediment supply tends to inhibit or retard subduction of oceanic lithosphere.

57638 Model and observed seismicity represented in a two dimensional space. Caputo, M. (Univ., Rome). *Ann. Geofis. (Rome);* **29**: No. 4, 277-288(1976).

In recent years theoretical seismology has introduced some formulae relating the magnitude and the seismic moment of earthquakes to the size of the fault and the stress drop which generated the earthquake. In the present paper we introduce a model for the statistics of the earthquakes based on these formulae. The model gives formulae which show internal consistency and are also confirmed by observations. For intermediate magnitudes the formulae reproduce also the trend of linearity of the statistics of magnitude and moment observed in all the seismic regions of the world. This linear trend changes into a curve with increasing slope for large magnitudes and moment. When a catalogue of the magnitudes and/or the seismic moment of the earthquakes of a seismic region is available, the model allows the maximum magnitude possible in the region to be estimated.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 56350, 56490

57639 (CONF-770478—P2, pp 1365-1372) **Groundwater studies in arid areas in Egypt using LANDSAT satellite images.** El Shazly, E.M.; Abdel Hady, M.A.; El Shazly, M.M. (Remote Sensing Center, Cairo). 1977.

From 11. symposium on remote sensing of environment; Ann Arbor, MI, USA (25 Apr 1977).

In Proceedings of the eleventh international symposium on remote sensing of environment. Vol. II.

The interpretation of LANDSAT satellite images for large areas in the deserts of Egypt has been going on for more than four years, and its comparison with the pertinent information on groundwater aquifers in these areas deciphered a considerable number of questions regarding the conditions, source and potential of the groundwater.

57640 P-wave residuals in Canada. Buchbinder, G. (Dept. of Energy, Mines, and Resources, Ottawa); Poupinet, G. *Can. J. Earth Sci.;* **14**: No. 6, 1292-1304(Jun 1977).

The aim of this study was to obtain station residuals for the Canadian network, hitherto unavailable, and relate them to tectonics across Canada, since Canada shows large variations in tectonics and has a uniform station net; 1692 short-period, vertical P-wave arrivals at the Canadian seismograph network from 82 events were reread and reduced to residuals with respect to the J—B tables. The epicentral distances of the data vary from 1° to 103°. The events occur mostly along the northern rim of the Pacific with a few sources in the Americas and Asia. For each event a baseline correction was determined and applied to the residuals. Station corrections

and distance corrections for 2° intervals were obtained by the method of successive approximations which is shown to be a stable and convergent technique. Station corrections are found to decrease with tectonic age of the stations. In addition, for those stations in several tectonic provinces where heat-flow data exist, the station corrections increase with increasing heat flow. The residuals remaining after subtraction of the station and distance corrections exhibit a complex distribution that implies inhomogeneity in some source regions and beneath some parts of Canada.

57641 Full utilization of seismic resolution: the key to deterministic stratigraphic interpretation from marine data. Nath, A.K.; Patch, J.R. pp 449-462 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Recently-developed technology has made meaningful quantitative stratigraphic interpretation possible. The role of waveform, wavelet shape, and duration is known to be vital in studies of reflection signal. The extraction and synthesis of these complex wavelets, generated by the various marine sources, leads to an understanding of the difficulties in the processing and interpretation of conventional marine data. The transformation of this complex wavelet to a simple response with zero phase response of short duration is an integral part of the recently developed technology "Wavelet Processing". "Wavelet Processing" reduces the complexity of the seismic trace and allows direct correlation of seismic reflection response and the lithologic sequence. This improvement in resolution allows the use of direct and inverse modeling procedures in deterministic interpretation. Quantification of subsurface parameters, such as velocity, porosity and thickness, from seismic information is made possible. Examples of the technology discussed demonstrate conclusively that the resolution of marine seismic data is the key to its use in stratigraphic interpretation. The utilization of knowledge of waveform duration and shape is vital in lithologic interpretation. Actual marine data cases and modeling examples are presented to support these conclusions.

57642 Deconvolution of marine source signatures. Wood, L.C.; Heiser, R.C.; Treitel, S.; Riley, P.L. pp 463-470 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Approaches for the removal of bubble oscillations from marine seismograms are proposed. The methods involve filters containing matched as well as least squares inverse components. The techniques are deterministic rather than statistical because explicit knowledge of the source pulse shape is required. The first approach leads to the design of a matched filter in cascade with a two sided Wiener-shaping operator. The second begins with the computation of the zero-delay Wiener filter that is inverse to the source signature, and continues with the autocorrelation of the resulting output. This performance is illustrated with synthetic as well as actual seismic data. The techniques are applicable in principle to any type of source; however, the examples displayed use Maxipulse and Aquapulse seismic records. Acoustic oscillations caused by successive expansions and contractions of gas bubbles initiated by the seismic source can be attenuated effectively with these filters, and the process has been called debubbling. The deconvolution procedures improve the definition of seismic reflections (resolution) by inverse filtering far-field source signatures, and the debubbling procedure is a first step in data processing prior to applying more refined deconvolution and pulse compression techniques.

57643 Maintaining three-dimensional integrity of a tuned source array. Lauhoff, T.A.; Woodall, J.C.; Sheriff, R.E.; Roark, R.L. pp 441-448 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Most published signatures of arrays of seismic sources have been obtained under static or near-static conditions. Under actual operating conditions the effective source characteristics may change, and the changes may be considerable along a seismic line. Experimental measurements of the far-field signature of an air-gun array made under operational conditions are described. Variations in marine source signature degrade the quality of seismic data. A major function of a source control system is to minimize shot-to-shot variations. Some source variations will remain despite source control. These can be removed in subsequent processing. Near-field waveforms are observed near each source on every shot. A composite wave-form is manufactured from these and recorded for each shot. Signature correction, a deterministic deconvolution process which utilizes this composite waveform, is applied to the data in subsequent processing to remove the effects of remaining source variations. An example shows the improvement in data quality which can be achieved by such processing.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 56603

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 56475, 56476, 56477, 56478, 56487, 56488, 56494, 56495, 56497, 56502, 56503, 57411, 57422, 57423, 57424, 57450

57644 Geology of the Bering Shelf. Blanton, S.L. Jr. (Sun Oil Co., Marcus Hook, PA). pp 7-10 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The Bering Shelf is a large shallow water shelf situated south of the Bering Strait, north of the Aleutian Islands and west of Alaska. The shelf contains four large Tertiary basins. The two largest basins, the Navarin and the St. George, are products of the Neutralization of an old North Pacific Oceanic plate. Near the beginning of Tertiary time the Kula plate ruptured near the present Aleutian Arc. The plate fragment on the northern side of the rupture was cut-off from its spreading center and Neutralized. The old Mesozoic subduction zone was transformed from compression to tension as the subducting downmoving tip broke away from the Neutralized fragment and continued downward. The result of the breakaway along the length of the old plate interface created two very large extensional basins. Together they are approximately 750 miles long, average over 100 miles in width, and are in excess of 30,000 feet deep. The obvious analog is the Gulf Coast Interior Salt Basins.

57645 Geologic hazards of the upper Continental Slope of the Gulf of Mexico. Garrison, L.E. (Geological Survey, Washington, DC); Tatum, T.E.; Booth, J.S.; Casby, S.M. pp 51-58 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

During 1975-76 the U.S. Geological Survey conducted a reconnaissance study of geologic hazards on the upper Continental Slope in the Gulf of Mexico. More than 14,000 miles (22,500 km) of high resolution seismic reflection profiles were made, large diameter piston cores taken from 37 locations, and smaller cores taken from 84 locations. Geological and geotechnical analyses were performed. Preliminary interpretation of these data indicates that many slump features are relict from late Pleistocene low sea levels but that some areas of present instability exist. Detailed examination of the slope area off the Mississippi Delta, for example, indicates active faulting, ancient slumps, and a large mudflow.

57646 Movement of sediment on the Gulf of Mexico Continental Slope and upper Continental Shelf. Woodbury, H.O.; Spotts, J.H.; Akers, W.H. pp 59-68 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Grain-size, coarse-fraction analyses and depositional environment as interpreted from microfauna are related to the character of sparker reflections at the location of core holes drilled by Exxon, Chevron, Gulf, and Mobil on the continental slope of the northern Gulf of Mexico. Continuous sparker reflections are correlated with slowly deposited, evenly bedded sediments containing bathyal faunas. The coarse fraction is dominated by the tests of foraminifera. Discontinuous, discordant reflections and diffractions are correlated with sediments more rapidly emplaced in the bathyal environment of the continental slope by slumping and sliding from the continental shelf. Their coarse fraction is dominated by terrigenous sand grains. A large portion of the volume of continental slope sediments appears to consist of these displaced sediments, including an area 3 to 24 km wide and 80 km long, southeast of Corpus Christi, Tex. Comparable precesses of movement of sediments are interpreted on the continental shelf south of the Southwest Pass of the Mississippi River. Bathymetry in this area is characterized by a series of subaqueous gullies radiating from the river mouth leading to terraces at their southern extremities. Side scan sonar and PDR surveys show a rough bottom in these gullies and terraces as contrasted with a relatively smooth bottom elsewhere. The rough bottom is interpreted as indicative of slump and creep of the sediments from shallower

water. Some foundation soil borings in this area south of Southwest Pass find a low strength material gradually increasing in strength with depth. Other borings find a crust of anomalously strong material 8 to 15 m below the mud line. the microfauna recovered from the crust has moved to its present position by slump or creep from shallower water along a pattern comparable with the gullies shown in the present-day bathymetry.

57647 Large dunes and other bedforms in lower Cook Inlet, Alaska. Bouma, A.H. (Geological Survey, Washington, DC); Hampton, M.A.; Wennekens, M.P.; Dygas, J.A. pp 79-90 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The surficial geology of lower Cook Inlet, Alaska, reveals: numerous fields containing bedforms of various sizes and types, a smooth bottom, sand patches, or boulders. High-velocity tidal currents exceeding 3 to 4 knots dominate the hydrodynamic environment. The fields normally are elongate in the axial direction of the inlet, parallel to the dominant tidal flow. Lengths of the fields normally exceed several kilometers; their widths range from a few hundred to a few thousand meters. Although ebb and flood surface currents in lower Cook Inlet are typically about 3.5 to 4 knots, currents of 5 to 6 knots are not exceptional. In the 25 km-wide constriction between upper and lower Cook Inlet, tidal currents may peak at 9 knots or higher. The most abundant group of bedforms are sand waves, some as large as sand ridges. Normally, smaller sand waves ride on their flanks, and opposing asymmetry may indicate opposite transport directions for the large and small waves. Dunes are less common and have not been seen covering large fields. Sand ridges, having their crests parallel to the current flow, are about 10 m high and have spacings of 300 to 400 m. Other bedforms observed are sand ribbons and sand patches, and gravel and boulder fields. Shallow parallel grooves, partly filled with small dunes, were observed on sonographs. Seismic studies indicate that these grooves occur where steeply dipping strata reach the surface and are sculpted by differential erosion. Although nothing is known about the migration of these various bedforms, the oppositely oriented asymmetry of large sand waves and the smaller superimposed ones suggests some degree of transport. Bottom television observations, revealing active motion in the form of small current ripples, support bottom transport.

57648 Comparison with observation at sea of period or height dependent sea state parameters from a theoretical model. Ezraty, R.; Laurent, M.; Arhan, M. pp 149-154 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A theoretical joint probability density for individual wave heights and wave periods, originally developed to describe storm conditions, is here compared with some 2,000 routine wave recordings in the Bay of Biscay. From the joint probability density, all other mean sea-state parameters (HT/sub 1/3/, TH/sub 1/3/, T/sub 1/3...) can be computed using H/sub 1/3/, anti T and epsilon, the spectrum width parameter. The systematic discrepancy existing between theory and observation can, if necessary, be corrected empirically.

57649 Directional spectra measurement by small arrays. Oakley, O.H. Jr.; Lozow, J.B. (Massachusetts Inst. of Tech., Cambridge). pp 155-166 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The directional resolution characteristics of sparse wave gage arrays in the measurement of directional wave spectra is investigated. The resolution capability of the maximum-liklihood-method (MLM) is compared with the standard (FFT) approach via computer simulated wave correlation data. The performances are contrasted graphically and quantified by a suitable figure of merit. The effects of wavelength, array size and geometry, and noise on resolution are discussed.

57650 Mid-Atlantic Outer Continental Shelf benchmark studies. Lynch, M.P. (Virginia Inst. of Marine Science, Gloucester Point). pp 231-238 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

During 1975, the Bureau of Land Management initiated an extensive study of the mid-Atlantic Outer continental Shelf area off the states of New Jersey, Delaware, Maryland, and Virginia. The benchmark or baseline portion of the study is being conducted by the Virginia Institute of Marine Science. The first year studies included extensive hydrocarbon and trace metal analysis of bottom sediments, benthos, zooplankton, neuston, and suspended sediments. In addition, studies of the benthic biota, including community dynamics, histopathology and bacteria populations were included, with supporting physical, chemical and geologic information. Two special studies were included in the benchmark studies, and extension of the Virginian Sea Wave Climate Model and a study of the rates of degradation of mixed cultures of naturally occurring bacteria from sediments and surface waters from the region. The second year studies at VIMS, which began with field sampling in November 1976, are essentially continuations of the first year studies with expanded water column studies and the addition of special studies. New special studies include a historical analysis of nekton communities, a recolonization study to determine rates of recolonizing benthic organisms, and a food habits study of benthic populations. The first year wave climate model is also being refined. Principal findings of the first year's benchmark studies are presented. In addition to the program funded at VIMS, BLM-sponsored mid-Atlantic studies are being done by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration.

57651 Iceberg and current drift using the Nimbus 6 Satellite. Brooks, L.D. pp 279-286 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Four drift buoys, two tethered to icebergs and two with current drogues, were deployed in Davis Strait, West Greenland. Each buoy was equipped with a transmitter that was tracked by the Nimbus-6 Satellite System. Position data were received from the System on an average of eight times per day. Drift speed histograms and drift tracks from two of the buoys are presented in this paper. A basic conclusion is that drift buoys tracked by the Nimbus-6 System offer a reliable, all-weather, long-term method for the collection of Lagrangian current data. Such data are applicable to investigations of iceberg drift and oil spill movement.

57652 Simultaneous passive and active microwave observations of near-shore Beaufort Sea ice. Campbell, W.J. (Geological Survey, Washington, DC); Gloersen, P.; Zwally, H.J.; Ramseier, R.O.; Elachi, C. pp 287-294 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The use of active and passive microwave imagery in combination is the optimum way to observe the morphology and dynamics of near shore ice. Active and passive microwave data from aircraft that are described in this paper are also compared to the ESMR (Electrically Scanning Microwave Radiometer) imagery of the Nimbus-5 satellite. The information thus obtained shows how the data to be received from the SAR (Synthetic Aperture Radar) and SMMR (Scanning Multichannel Microwave Radiometer) and on Seasat A and Nimbus G have the potential of providing a vastly increased understanding of the near shore ice of the Beaufort Sea.

57653 Ocean surface winds from Seasat-A. Pierson, W.J.; Cardone, V.J. (City Coll., New York). pp 303-310 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The present status of the use of the SASS (Scatterometer Satellite System) on SEASAT-A is reviewed based on SKYLAB and aircraft programs. Procedures, which are under development, to obtain vector wind fields from the SASS data in a form that will permit their operational use in computer based numerical weather forecasting are described.

57654 Geotechnical predictor equations for east central north Pacific nodule mining area sediments. Richards, A.F.; Parks, J.M. (Lehigh Univ., Bethlehem, PA). pp 377-386 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Simple predictor equations, relating individual geotechnical parameters to depth, have been developed from data generated by the laboratory testing of 34 short (300 mm) cores collected by USGS, NOAA, and Deepsea Ventures personnel. A general set of equations is applicable to seafloor area of about 4 million square kilometers (10 to 20°N. lat. and 120 to 150°W. long.). Three other sets of equations are presented for limited areas within the general region: Deepsea Ventures mining claim, DOMES Site C, and DOMES Site A and B, in which siliceous pelagic clay and pelagic clay are the predominant sediment types. In addition, one set of predictor equations is given for the variable types of sediment located in the vicinity of the Hawaiian Islands.

57655 Consolidation state of Upper Continental Slope sediments, northern Gulf of Mexico. Booth, J.S. (Geological Survey, Washington, DC); Dunlap, W.A. pp 479-488 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The stability of the Upper Continental Slope sediments of the northern Gulf of Mexico was examined by estimating the degree of consolidation of the sediments. Geotechnical properties of 14 piston cores coupled with analysis of deposition rates provided the data base for the interpretations. Degree of consolidation was estimated by using two independent methods. The first method was based on a comparison of measured and empirically derived shear strength values, where the derived values were representative of expected strengths in normally consolidated sediment. Disagreement, therefore, signified a departure from normal consolidation. The second method permitted direct computation of degree of consolidation by using the sedimentation rates in conjunction with consolidation theory. Results from both methods indicate that in general the sediment on the upper slope is normally consolidated to slightly underconsolidated, although examples of moderate underconsolidation and overconsolidation may be found. These deviations are rare, thus most areas are considered essentially stable with respect to the surficial sediment. Local variability precludes extrapolation of this conclusion to sites not covered in this study.

57656 Dynamic behavior of a northeast Pacific clay. Ling, S.C. pp 495-502 of Ninth annual offshore technology conference. Proceedings. Volume I. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Very soft soils to the NE of Hawaii were investigated for the degradation of shear strength due to cyclic excitation. The soils are typical of much of the deep sea floor. Consolidated-undrained, strain-controlled dynamic, and static strength tests were performed with a torsional simple shear device on NE Pacific pelagic clays (red clay). The soils investigated are in the region of potential marine mining and are typical of much of the sea floor. The results are applicable to designers of mining systems and deep-sea anchoring of ocean thermal-energy conversion systems. The results should also be applicable to consideration of piling or gravity foundations in very soft cohesive sea-floor soils. The cyclic strength ratio, S/sub c//S/sub u/: (1) decreased from unity for n/sub c/ <50 to 0.67 for n/sub c/ = 6,500 for γ/sub p/ = 1.3% and f = 0.25 Hz, (2) decreased from unity at γ/sub p/ = 0.3% to 0.88 at γ/sub p/ = 2.2% for n/sub c/ = 200 and f = 0.25 Hz, and (3) decreased according to S/sub c//S/sub u/ = 0.90 - 0.035 log f for 0.025 approximately less than or equal to f approximately less than or equal to 10 Hz and for γ/sub p/ = 2.2% and n/sub c/ = 200. G ranged from 462 kPa for n/sub c/ = 10 to 183 kPa for n/sub c/ = 6,500 for γ/sub p/ = 1.3% and f = 0.25 Hz. D remained constant at 19.9% for 10 < n/sub c/ < 6,500, γ/sub p/ = 1.3%, and f = 0.35 Hz.

57657 North Sea weather data review: 1971—1977. Kobus, L.C.S.; Guntur, S.R. pp 299-308 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Offshore weather and sea conditions have been monitored on three Zapata Off-shore Company jackup rigs covering the period of 1971-1977 in extensive North Sea drilling operations. This report presents the analysis of wind velocity and wave height distributions recorded at 57 different locations in the North Sea operating area. During the recording period, a maximum wind of 104 knots and a maximum wave of 66 feet were experienced. This data and its analysis can be of widespread value in planning evaluations for future North Sea offshore operations.

57658 Extreme wave heights along the Atlantic Coast of the United States. Ward, E.G. (Shell Development Co., Houston, TX); Evans, D.J.; Pompa, J.A. pp 315-324 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A study of storm generated waves in the Georges Bank, Baltimore Canyon, and Georgia Embayment is presented. Waves were hindcast for all severe hurricanes which have affected these areas between 1900-1975, and used to determine the statistics of hurricane generated waves. Several severe winter storms were also hindcast to compare the severity of hurricane and winter storm generated waves. The extreme wave statistics determined in this study are less severe than results presented by other investigators. Possible reasons for these differences are discussed.

57659 North Sea model that can provide detailed hydrographic information. Rodenhuis, G.S.; Kjaer, O.B.; Bertelsen, J.A. pp 325-330 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Severe storm conditions and normal tidal conditions in the North Sea have been used to verify a fast running computer model based on the complete nonlinear equations for nearly horizontal flow, including wind stresses, barometric pressure gradients, Coriolis forces and bottom shear stresses. The model can focus on freely selected areas where the mesh size is reduced to $^1/_9$-th of that of the coarsest grid. The detail of the local area is computed simultaneously in the fine grid from the general conditions in the coarse grid. When complemented with a short, intensive program of local measurements, the model can provide detailed information on currents and surface elevations. This allows forecasts of extreme conditions and statistics of occurrences and magnitudes on the basis of meteorological information.

57660 Some new techniques for hurricane risk analysis. Borgman, L.E. (Univ. of Wyoming, Laramie). pp 331-338 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

For many years, hurricane risk studies have focused on return periods, encounter probabilities, or other measures of risk for storms of different intensities. The corresponding problem of estimating the probability law for the total damage cost during a given operational life for an oil-drilling structure has not received as much emphasis. Although studies have been published which develop such damage probabilities for special choices of input functions, these have not been used very much in practice. The real world has usually failed to fit the neat models required in the formulas. The methods developed in the present paper allow the efficient numerical computation of the total damage probabilities by numerical, rather than algebraic, procedures. Computer procedures based on the fast Fourier transform algorithm and the statistical method of characteristic functions permit the computations to proceed directly from penciled curves or approximate numerical estimates prepared by the engineer. Although the procedures are developed and illustrated particularly for hurricane damage and platform reliability relative to offshore structures, the general method is equally applicable to any situation where a random number of independent damaging events occur and each event has a probability law for damage associated with it.

57661 Wind and wave model for hurricane wave spectra hindcasting. Kolpak, M.M. pp 339-348 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

A five parameter wind model and a modified PTB wave model are outlined. The results of tuning the wave model are shown in comparison with one-dimensional wave spectra measured during the joint industry Ocean Data Gathering Program. An example application of hindcast results for 28 historical hurricanes to estimate extreme wave directional statistics is outlined. 100- and 50-year wave height contours for the continental shelf offshore Louisiana are presented.

57662 Project SEASWAB: real-time acquisition/reduction of submarine sediment data. Niper, E. (Sandia Labs., Albuquerque, NM); Williams, G. pp 475-480 of Ninth annual offshore technology conference. Proceedings. Volume II. Dallas, TX; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Project SEASWAB is a multi-disciplinary research effort considering primarily the stability of underconsolidated sediments in the Gulf of Mexico. A significant part of this study is the real-time acquisition, transmission, and subsequent reduction of the offshore time-dependent data gathered during the project. The SEASWAB field instrumentation includes submarine accelerometers, piezometers, pressure sensors, and a waverider buoy. Twelve time histories selected from these sensors are analog recorded in the field on a slow speed recorder. All data channels are also sampled and transmitted via an "S" band RF link to an onshore receiving station, which then buffers this signal into a voice-grade line for transmission to Texas A and M University. At this point the data are reconstructed, displayed and optionally analog recorded. Subsequent reduction of both the field and remote station-recorded data includes the analog-to-digital conversion and calibration, spectral computations, and graphic output generation. SEASWAB was initiated in October 1976, with initial data recording/transmission beginning in early December 1976. Scheduled for operation through the 1977-1978

winter, the data gathered and analyzed will be a valuable tool in assessing the causes of submarine sediment instability.

57663 Diverse geology of Atlantic-type continental margin and some possible implications for U.S. offshore Atlantic. Burke, K. (State Univ. of New York, Albany). pp 77-84 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Recognition of the plate structure of the lithosphere and consequent appreciation of the high lateral mobility of continents has revolutionized geology in the last decade, but understanding that Atlantic-type margins have formed at continental rupture has been followed by increasing awareness of along-strike diversity in their development. Factors generating this diversity include: the distribution of hot spots within the continent at rupture; distribution and pattern of failed-rift systems at the continental margins and related distribution of continental headlands and embayments; the occurrence of ridge and transform sectors of the continental margin; occurrence of deltas, prograding down-failed rift systems; distribution of salt deposits formed at ocean opening; temporal variations in rates of clastic sediment supply; and oceanic and atmospheric circulation. Geological development of Atlantic-type margins also varies with climate. Subsidence at Atlantic-type margins is controlled mainly by age, rate of sediment supply, and eustatic sea level. At the present stage in the study of Atlantic-type continental margins, general understanding of the basic processes that operate during development has been achieved, but because of the variety of the processes involved, Atlantic margins show great along-strike diversity so that there is less need now for refinements of general continental margin models than for comprehensive analysis of the best known areas to see how the interaction of the different processes can produce varied results. Thorough mapping of the distribution of failed-rift systems around the oceans seems an essential first step in understanding diversity.

57664 Bottom stability as a factor in platform siting and design. Garrison, L.E. (Geological Survey, Washington, DC); Bea, R.G. pp 127-133 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

The stability of bottom sediments is a critical factor in the emplacement of offshore platforms. It should first be investigated early in the pre-siting stage when reconnaissance surveys might reveal areas to be avoided or conditions that must be accommodated. More detailed studies of specific sites should follow to characterize local soil properties. In the design process, sea floor soils and the foundation elements of the platform should be considered as two components of a single system that together comprise the platform substructure. The strength and load-deformation characteristics of the soils, just as any other element of the platform system, must be determined for the projected lifetime of the facility. Principal sea floor instabilities are downslope mass movements of sediments, sediment moved about by various transporting agents, and faulting. These can be recognized and characterized by a five-part program of interdisciplinary study consisting of geology, geophysics, environmental mechanics, soil reconnaissance, and the development of analytical models. To provide the basic research for understanding these problems, acquire adequate information on bottom stability in frontier areas, and build and maintain a data base for input to analytical models, a cooperative effort between industry and government will be necessary.

57665 Stamukhi zone processes: implications for developing the Arctic offshore. Reimnitz, E.; Toimil, L.J.; Barnes, P.W. (Geological Survey, Washington, DC). pp 513-518 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Landsat-1 and NOAA satellite imagery for the winter 1972-1973, together with a variety of ice and sea-bed data, including side-scan sonar, high-resolution (Uniboom) seismic reflection, and precisely controlled bathymetric surveys, were used to study sea ice zonation and dynamics and their relation to bottom morphology and geologic processes on the Beaufort Sea continental shelf of the Alaskan Arctic. During early winter, the location of the boundary between undeformed fast ice and the westward drifting polar-pack ice is controlled by major coastal promontories. Pronounced linear pressure and shear ridges as well as hummock fields form along the boundary and are stabilized by grounding, generally between the 10- to 20-m isobaths. Slippage along this boundary occurs intermittently at or seaward of the grounded ridges, forming new grounded ridge systems in a widening zone—the stamukhi zone—that by late winter may extend out to the 40-m isobath. The stamukhi zone protects the inner shelf and coast from pack ice forces. The concentration of large-scale ice deformation and intense sea-floor disruption in the stamukhi zone indicate that a considerable amount of the available marine energy is expended here during winter. The inner shelf and coast, where the relatively undeformed fast ice grows, is sheltered. Certain aspects of the results reported are directly applicable to planned offshore developments in the Beaufort Sea. Artificial structures similar to offshore shoals, properly placed, should be able to withstand the forces of the ice, serve to modify the observed ice zonation, and might be used to make the inner shelf environment less hostile to man's endeavors.

57666 Sea bottom scouring in the Canadian Beaufort Sea. Hnatiuk, J.; Brown, K.D. (Gulf Oil Canada Ltd., Sheridan Park, Ont.). pp 519-527 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Echo sounding, side scan sonar and seismic profile records in the Canadian Beaufort Sea provide evidence of trenches or scours on the continental shelf sea bottom. These are generally believed to be caused by grounding of ice masses. Records obtained over a three year period by government and industry were analyzed with particular regard to frequency of scouring and scour azimuth, depth and width. Approximately 1100 n. miles of echo sounding records and 1900 n. miles of side scan sonar records obtained in 1970, 1971 and 1972 were examined in detail during the study. These totals were made up by choosing every third or fifth mile of available records. The variations of these parameters with location are shown on maps and their relationship with water depth are presented on histograms. Speculative discussion regarding causes of scouring, scour rates and sedimentation within scours is also presented. Two areas were selected where parallel side scan sonar tracks were run to prepare mozaics of the sea bottom. These areas were later resurveyed to determine the number of scours added over several years. It has been found that the preferred orientation of the scours is 105 to 285°. Scouring is most common in water depths between 50 and 150 ft where many areas are nearly saturated with scours. Maximum activity occurs at approximately 100 ft. Normally scours do not exceed 6 ft but in places they occur up to 20 ft in depth. Scour widths range from tens of feet to hundreds of feet. The tendency is for scours to become deeper in deeper water. The depth of scouring is particularly important in design of protection for offshore wells and future pipelines. The most important parameters in this regard are the depth of scours and the rate of new scouring.

57667 Atmospheric superstructure ice accumulation measurements. McLeod, W.R. (Marathon Oil Co., Findlay, OH). pp 555-564 of Ninth annual offshore technology conference. Proceedings. Volume III. Dallas; Offshore Technology Conference (1977).

From Offshore technology conference; Houston, TX, USA (2 May 1977).

Ice accumulation measurements made on Middleton Island in the Gulf of Alaska at a 10 meter elevation during the winter of 1975-1976 and on St. Paul Island in the Bering Sea during the fall of 1976 and the winter of 1976-1977 at 10, 20, and 30 meter elevations are reported along with meteorological conditions prevalent before, during and after icing events. The data obtained is used in an attempt to establish preliminary methods for design recommendations for offshore atmospheric superstructure icing on derricks, flare booms, antennas, quarters and superstructures on an offshore platform located in subarctic or Arctic regions.

PHYSICS RESEARCH

57668 (UCID—17271-78) **E-Division activities report.** Barschall, H.H. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-48. 64p. Dep. NTIS, PC A04/MF A01.

This report describes some of the activities in E (Experimental Physics) Division during the past year. E-Division carries out research and development in areas related to the missions of the Laboratory. Many of the activities are in pure and applied atomic and nuclear physics. In addition, this report describes work on accelerators, radiation damage, microwaves, and plasma diagnostics. Detailed results of the research are published in the scientific literature and reported at scientific meetings.

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

57669 Analysis of experimental data on the lateral distribution of particles at large distances from the axis of an EAS with a total of 10^7—10^8 particles. Atrashkevich, V.B.; Vedeneev, O.V.; Kulikov, G.V.; Solov'eva, V.I.; Khristiansen, G.B. (Nuclear Physics Institute, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 303-306(Sep 1977).

The experimental data on the lateral distribution of particles at distances up to 3.5 Moliere units in showers with 10^7—10^8 particles, obtained at the Moscow State University installation, are compared with data of other studies. The data from the installations at Moscow State University, Yakutsk, Sydney, and Volcano Ranch (at a zenith angle 36°) are in sufficiently good agreement as to the average lateral distribution function. A large discrepancy is observed between the data of the Tokyo and Chakaltai installations (at a zenith angle 60°), on the one hand, and all the remaining data on the other. The analytic form of the average lateral distribution of the particles is presented.

STARS

57670 ^{7}Li production in Nova explosions. Starrfield, S.; Truran, J.W.; Sparks, W.M.; Arnould, M. (Department of Physics, Arizona State University; and Los Alamos Scientific Laboratory). *Astrophys. J.;* **222**: No. 2, 600-603(1 Jun 1978).

Calculations of ^{7}Li production occurring as a concomitant of thermonuclear runaways in hydrogen envelopes of white dwarfs are reported. It is found that sufficient ^{7}Li can be produced in models displaying fast—nova-like features to suggest that the corresponding objects represent significant contributors to the ^{7}Li enrichment of galactic matter. The sensitivities of these results to various assumptions and uncertainties are discussed.

57671 Cepheid masses and cepheid winds. Cox, A.N.; Michaud, G.; Hodson, S.W. (Theoretical Division, Los Alamos Scientific Laboratory, University of California). *Astrophys. J.;* **222**: No. 2, 621-626(1 Jun 1978).

Masses of Cepheids with bumps in their light and velocity curves (bump Cepheids) and those with two pulsation modes (beat or double-mode Cepheids) can be made equal to masses obtained from the evolution theory mass-luminosity relation if they have helium-enriched convection zones. The cause of this enrichment cannot be diffusion of helium-enriched convection zones. The cause of this enrichment cannot be diffusion of helium from below with subsequent mixing in and between the H+He I and He II convection zones. The probable cause of the composition inhomogeneity seems to be a Cepheid wind which depletes hydrogen more than helium as apparently occurs in the solar wind. A layer with $Y=0.75$ and $Z=0.02$ external to the 70,000 K level allows 7 M/sub sun/ Cepheids to give the proper periods and light and velocity curve bumps at their evolution theory luminosity. This helium-deficient wind, if only a little stronger than that in the Sun, needs 10^6—10^7 years. Barely enough time is available for 7 m/sub sun/ Cepheids, but there is plenty for the 4—5 M/sub sun/ beat Cepheids to give their observed period ratios.

57672 Nuclear reactions in Ap stars. Kowalski, M. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 464-472(Sep 1977).

Data derived from astronomical observations of Ap stars are presented. The theory of the anomalous chemical composition of Ap stars is briefly presented: diffusion theory, magnetic accretion, nuclear reactions on the surface and within the star. The isotopic abundance of mercury and the discovery of promethium in the atmospheres of Ap stars are considered. The attempts at theoretical explanation of these observations are reviewed. It is impossible to explain all features of the chemical composition of the atmospheres of Ap stars by just one of the mechanisms discussed in the paper. The features of Ap stars emphasize the importance of further observations and also calculations of the abundance of promethium and the transuranium elements in the atmospheres of these stars.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

57673 (NTIS/PS—78/0161) Quasars, pulsars, and black holes (a bibliography with abstracts). Report for 1964—February 1978. Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 277p. NTIS PC N01/MF N01.

Astronomical surveys of quasars, pulsars, and black holes are cited. Computer simulations, mathematical models and other methods used for the verification of hypotheses about astrophysical processes are included. (This updated bibliography contains 273 abstracts, 15 of which are new entries to the previous edition.)

SOLAR PHENOMENA

57674 (AD-A—051137) Solar magnetic fields study. Final report, 18 March—30 September 1977. Smithson, R.C.; Title, A.M. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). 31 Oct 1977. Contract F19628-77-C-0128. 19p. (LMSC-D—567280). NTIS PC A02/MF A01.

High-resolution observations of quiet sun magnetic fields have been made at Sacramento Peak Observatory by using the Lockheed Universal Filter. The existence of 'salt and pepper' fields described by other observers has been called into question.

57675 (PB—276709) Photometry and polarimetry of the solar corona of 30 June 1973. Technical note. Lilliequist, C. (High Altitude Observatory, Boulder, CO (USA)). Dec 1977. 90p. (NCAR/TN—128). NTIS PC A05/MF A01.

The High Altitude Observatory's coronal camera successfully photographed the 30 June 1973 eclipse (from the National Science Foundation Eclipse Expedition Camp at Loiyengalani, Kenya) for the purpose of acquiring white light photometry, polarization, and high-resolution, radially graded filtered pictures of the inner corona. The method of reduction, its strengths and weaknesses, and suggestions for improvements are discussed. A comparison of our coronal camera observations is made with other ground-based observations of Koutchmy, Hansen, and Saito (and Moriyama), the rocket observations of Koomen, the aircraft observations of Keller and the ATM Skylab observations of Poland and Munro. Generally excellent agreement in white light photometry and polarimetry of the North Polar coronal region is most encouraging, while the discrepancies in other regions should provide insights into instrumental limitations or directions for future refinements.

57676 (PB—277096) Solar—geophysical data number 399, November 1977. Part I. (Prompt reports). Data for October 1977—September 1977. Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Nov 1977. 130p. (SGD—399(Pt.1)). NTIS PC A07/MF A01.

This prompt report provides data for October 1977 on alert period, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, coronal holes, solar wind measurements, spacecraft observations, inferred IP magnetic field polarities, and mean solar magnetic field. It also provides data for September solar radio waves, cosmic rays, geomagnetic indices and radio propagation indices.

57677 (PB—277097) Solar—geophysical data number 399, November 1977. Part II. (Comprehensive reports. Data for May 1977—April 1977 and miscellanea. Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Nov 1977. 43p. (SGD—399(Pt.2)). NTIS PC A03/MF A01.

This comprehensive report for May 1977, April 1977 and Miscellaneous data provides data on active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, regional flare index, solar radio waves for August 1977 and solar x-ray radiation for September 1977.

57678 (PB—277098) Solar—geophysical data number 400, December 1977. Part I. (Prompt reports). Data for November 1977—October 1977. Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Dec 1977. 123p. (SGD—400(Pt.1)). NTIS PC A06/MF A01.

This prompt report provides data for November 1977 on alert period, daily solar indices, solar flares, solar radio waves, solar X-ray radiation, coronal holes, inferred IP magnetic field polarities, mean solar magnetic field, and solar wind measurements. It also provides data for October 1977 data on daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices and radio propagation indices.

57679 (PB—277099) Solar—geophysical data number 400, December 1977. Part II. (Comprehensive reports). Data for June 1977—May 1977 and miscellanea. Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Dec 1977. 76p. (SGD—400(Pt.2)). NTIS PC A05/MF A01.

This comprehensive report for June 1977, May 1977 and Miscellaneous data provides data on active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, regional flare index, daily solar activity centers for September 1977, solar radio waves, and cosmic rays for August and September 1977, and abbreviated calendar record for April 1977.

COSMOLOGY

57680 Gravitational experiments in space. Konopleva, N.P. *Sov. Phys. - Usp. (Engl. Transl.);* **20**: No. 12, 973-988(Dec 1977).

The latest achievements in the experimental verification of Einstein's theory are reviewed. The classical relativistic experiments,

together with the possibility of testing the existence of non-Einstein effects, are discussed. Some programs for relativistic experiments with space probes are examined.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 57676, 57678

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

57681 (AD-A—049503) **High altitude limit of the gradient drift instability. Interim report.** Ossakow, S.L.; Chaturvedi, P.K.; Workman, J.B. (Naval Research Lab., Washington, DC (USA)). Nov 1977. 30p. (NRL-MR—3639). NTIS PC A03/MF A01.

The gradient drift instability for F region plasma clouds is investigated with ion inertia effects retained. Under the assumption that the ion gyrofrequency, Omega, is greater than inertial time changes (delta/delta T and divergence of V sub I) and the ion-neutral collision frequency, V sub in, a quadratic dispersion equation results. In the limit that V sub in $>>$ 4cE $_0$/BL (E_0 and B are the ambient electric and magnetic fields, and L is the plasma cloud density gradient scale length), the growth rate, gamma, reduces to the usual result CE $_0$/BL. In the opposite limit v sub in $<<$ 4cE $_0$/BL, gamma = (CE $_0$ V sub in/BL) to the 1/2 power. This result can explain why high-altitude (approximately 450 km) Barium releases, where v sub in is less than unity and a factor of 10-100 smaller than at lower altitudes (Approximately 200 km), striate on time scales similar to the lower altitude releases.

57682 (AD-A—051335) **A quantitative model of ionospheric electron density. Final report, February 1975—February 1978.** Olson, W.P.; Pfitzer, K.A. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). 28 Feb 1978. Contract N00014-75-C-0821. 47p. (MDC-G—7433). NTIS PC A03/MF A01.

This report summarizes work performed during the entire contract period. The general goal was to develop a quantitative global ionospheric electron density model that can be used to predict variations in the electron density. The model developed under this contract represents the electron density at all latitudes and local times, it is computationally fast and can be used in a predictive mode. The electron density model relies on physical input parameters that can be measured directly (intensity of bands of the solar electromagnetic spectrum and the density of the solar wind). The model features include structure of the E, F1, and F2 layers, the day-night changes, the equatorial and seasonal anomalies and dependences on several forms of solar variability.

57683 (PB—276387) **Analysis of the relationship between LF reflection coefficients and D-region profiles. Technical memo.** Jones, R.M. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Wave Propagation Lab.). Nov 1977. 51p. (NOAA-TM-ERL-WPL—29). NTIS PC A04/MF A01.

In calculating D region electron density profiles from LF reflection coefficient measurements, it is important to order those measurements according to depth of penetration into the ionosphere. A ray theory analysis, a set of full-wave reflection coefficient calculations, and reflection coefficient measurements support the approximation that those waves with the larger equivalent frequency f($\cos^2 i_0$) (where f is the wave frequency and i_0 is the angle of incidence on the ionosphere) will penetrate further into the ionosphere. This approximation is more accurate for those waves that reflect below the height where the collision frequency equals the gyrofrequency (about 65 km at midlatitudes), where the earth's magnetic field has negligible effect.

EFFECTS OF NUCLEAR DETONATIONS

REFER ALSO TO CITATION(S) 57913

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 57676, 57678

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

57684 (COO—2807-11) **Experimental investigation of the chemistry of excited states of rare gases. Annual technical progress report, October 15, 1976—October 14, 1977.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Jan 1978. Contract EY-76-S-02-2807. 10p. Dep. NTIS, PC A02/MF A01.

Tunable dye laser fluorescence has been combined with the flowing afterglow technique as a method for studying reactive intermediates present in the flowing afterglow. The radiative lifetimes and two-body quenching rate constants (with Ar carrier gas) for the Ar*($3p^5$,4p) and Ar*($3p^5$,5p) excited states were reported in the preceding year. During this year, we have measured the Ar* product states from the two-body quenching. More than 50% of the quenching leads directly to intermultiplet transfer to Ar(4s) states, rather than to intramultiplet cascade down the Ar(4p) manifold. Using this technique we also have studied the Xe($5p^5$,6p') and Xe($5p^5$,7p) excited states and radiative lifetimes, two-body quenching and the product states from quenching have been ascertained. These data should be of value for modeling energy flow pathways of rare gases excited by high energy electrons. A method has been developed for studying the quenching of the XeF(B) and KrF(B) by a variety of reagent molecules. A preliminary account of this work was published (number 5 in the publication list). Much additional experimental work has been done and a definitive study of the electronic quenching of XeF(B) and KrF(B) is in progress. Efforts to interpret (and publish) our comprehensive studies of the reactive quenching of the Kr($^3P_2$) and Xe($^3P_2$) by fluorine and chlorine-containing molecules has continued (see numbers 4, 6 and 8 in the publication listing). Two more manuscripts are in final stages of preparation. Of particular importance has been the development of methods for simulating and interpreting the bound-free emission spectra from the very high vibrational levels of the xenon and krypton fluorides and chlorides. Experiments have been done to measure the branching ratios for (i) ArF* formation from reactive quenching of Ar($^3P_2$) with fluorine-containing reagents and (ii) KrBr* and Br* formation for Kr($^3P_2$) reacting with some bromine-containing molecules.

57685 **Analysis of aggregate optical spectra using moments. Application to the purple membrane of halobacterium halobium.** Hemenger, R.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **69**: No. 6, 2279-2285(15 Sep 1978).

The problem of extracting structural information from the optical spectra of aggregates of molecules interacting through their electronic transitions is studied. One serious difficulty common to all approaches to this problem is that of properly taking into account the effects of molecular vibrations. A series of exact relations derived previously which are correct with regard to molecular vibrations provide a number of independent, explicit connections between aggregate geometrical parameters and moments of experimental spectra. It is shown that, by applying these moment relations to the optical absorption and circular dichroism spectra of simple aggregates, a complete set of equations can be found, i.e., enough equations can be found to solve for all of the geometrical parameters which enter into the expressions for absorption and circular dichroism spectra. This procedure is applied in some detail to the purple membrane of Halobacterium halobium. The results are completely consistent with what is known about its structure.

57686 **Lifetime saturation of SO_2 ($^3B_1$) molecules: evaluation of chemical and physical quenching channels in alkanes.** Wampler, F.B.; Oldenborg, R.C.; Rice, W.W.; Karl, R.R. Jr. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 6, 2569-2573(15 Sep 1978).

Lifetime data at 25 °C for the decay of SO_2 ($^3B_1$) molecules have been obtained in the presence of high pressures of CH_4, C_2H_6, and C_3H_8. At high pressures, the physical quenching channel saturates and a kinetic model which incorporates this effect has been applied to the SO_2, alkane systems studied. This model permits one to evaluate the partitioning of the total quenching rate constants into their chemical and physical components. The value (in units of 10^3 $torr^{-1}$ s^{-1}) of the chemical and physical quenching rate constants (zero pressure limit), respectively, are (0.18 and 4.70), (CH_4); (1.66 and 7.70),(C_2H_6);and (12.5 and 6.5), (C_3H_8).

57687 **Thermally stable negative ions of polar molecules.** Garrett, W.R. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **69**: No. 6, 2621-2626(15 Sep 1978).

A simple molecular pseudopotential method is utilized to outline the strengths of permanent and induced moments of polar molecules which are sufficient to insure the existence of stable negative ions with specified electron affinities in the range of thermal collisional energies.

57688 **Theoretical studies of the low-lying electronic states of GaKr, including extrapolation to InKr and TlKr.** Dunning, T.H. Jr.; Valley, M.; Taylor, H.S. (Chemistry—Nuclear Chemistry Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 6, 2672-2681(15 Sep 1978).

We report ab initio configuration interfaction calculations on the states of the gallium krypton (GaKr) molecule arising from the Ga(^{2}P/sub 1/2,3/2/,^{2}S/sub 1/2/) + Kr(^{1}S/sub O/) and Ga$^+$(^{1}S/sub O/) + Kr(^{1}S/sub O/) separated atom limits. The potential

energy curves for the states arising from the Ga(²P/sub 1/2,3/2/) limits, the I 1/2, II 1/2, and I 3/2 states, are found to be repulsive. The potential energy curves for the states arising from the Ga(²S/sub 1/2/) and Ga⁺ (¹S/sub O/) limits, the III 1/2 and I 0 states, are both found to be weakly bound; D/sub e/ (III 1/2) = 0.047 eV and D (I 0) = 0.24 eV. The potential energy curves and transition moments obtained in the GaKr calculations have been used to simulate the curves and moments for InKr and TlKr. Using this data the absorption and emission coefficients of all three molecules have been calculated.

57689 Accurate H_3 dynamics on an accurate H_3 potential surface. Walker, R.B.; Stechel, E.B.; Light, J.C. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 6, 2922-2923(15 Sep 1978).

Converged quantum close coupling calculations for the hydrogen exchange reaction on the chemically accurate potential surface of Siegbahn and Liu, using the fit of Truhlar and Horowitz, are reported. Comparisons are made with the Porter—Karplus potential energy surface.

57690 Analysis of $3\nu_3$ in SF_6. Ackerhalt, J.R.; Flicker, H.; Galbraith, H.W.; King, J.; Person, W.B. (University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 4, 1461-1464(15 Aug 1978).

Studies of the $3\nu_3$ absorption band in SF_6 in the spectral region from 2800 to 2850 cm^{-1} have been completed with a FT—IR spectrometer at a spectral resolution of 0.04 cm^{-1}. This study confirms the results reported earlier by Kildal on the general shape of this absorption band. The absorption has been studied as a function of temperature, allowing a definite assignment to be made of the ground state features observed in this spectrum at room temperature. The ground state absorption to $3\nu_3$ appears with a double Q branch [estimated band origins at 2830.22 and 2827.62 (+- 0.06) cm^{-1}]. The intensities and temperature dependence studies confirm the assignment by Fox of these two Q branches to the two F/sub 1u/ components of the $3\nu_3$ state.

57691 Chemical-state effects in Auger electron spectroscopy. Rye, R.R.; Madey, T.E.; Houston, J.E.; Holloway, P.H. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Chem. Phys.;* **69**: No. 4, 1504-1512(15 Aug 1978).

We have used Auger spectroscopy as a probe of local chemical environment both in the gas and condensed phases using a systematically chosen series of molecules [H_2O, CH_3OH, $(CH_3)_2O$, CH_4, C_2H_4, and C_2H_2]. For the series of gas phase molecules, H_2O, CH_3OH, $(CH_3)_2O$, and CH_4, where oxygen and carbon are, respectively, in similar bonding arrangements, characteristic fingerprint spectra (methanelike for C and waterlike for O) are shown to result. Additional fine structure, which is dependent on the specific molecular environment, appears on the spectra. In contrast, dramatic differences are observed for the series CH_4, C_2H_2, and C_2H_4 in which major differences in hybridization exist at the carbon site. H_2O, CH_3OH, and $(CH_3)_2O$ were studied both in the gas phase (electron excited) and in the condensed phase (x-ray excited). The O(KVV) (K level—valence—valence transition) and C(KVV) spectra are shown to be similar when comparing the gas—solid results only if the multilayer spectra are properly corrected for electron-loss effects. Some "solid-state" broadening is observed in the multilayer case. The degree of this broadening is found to be greater in the O(KVV) than for the C(KVV) and a new peak appears in the case of solid H_2O which is not present in the gas phase. This is consistent with intermolecular bonding primarily at the oxygen site. These results demonstrate, along with the fingerprint correlations given above, that AES is sensitive to changes in the local environment.

57692 Measurements of some line positions and strengths in the ν_4 region of SF_6. Person, W.B.; Kim, K.C. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 4, 1764-1769(15 Aug 1978).

Absolute "line strength" measurements with a diode laser spectrometer are reported for a number of J-manifolds for ν_4 of SF_6 in the gas phase. These results are analyzed to obtain the ν_4 vibrational band strength: S°/sub V/equivalentA = (83 +- 11 km $mole^{-1}$. A critical discussion is presented of errors in line and band strength measurements in general, and of these results in particular. The experimental procedure was calibrated by measurements on several rotational lines in ν_2 of N_2O; the vibrational band strength derived for that transition in N_2O is S°/sub V/=A=7.71 +- 0.76 km $mole^{-1}$, in excellent agreement with the literature value from total integrated band area measurements. The measured value for S°/sub V/ for ν_4 of SF_6 is compared with literature values, and the discrepancy is discussed.

57693 Oscillator strengths of the 2s ²S/sub 1/2/-2p ²P/sup o//sub 1/2,3/2/ transitions in Fe XXIV and the 2s² ¹S_0-2s2p ³P/sup o/$_1$ transition in Fe XXIII. Dietrich, D.D.; Leavitt, J.A.; Bashkin, S.; Conway, J.G.; Gould, H.; MacDonald, D.; Marrus, R.; Johnson, B.M.; Pegg, D.J. (University of Arizona, Tucson, Arizona 85721). *Phys. Rev., A;* **18**: No. 1, 208-211(Jul 1978).

We have used the beam-foil technique to measure the mean lives of the upper levels of: (i) the 2s ²S/sub 1/2/ - 2p ²P/sup o//sub 1/2,3/2/ resonance transitions (at 255 and 192 A) in lithiumlike Fe XXIV and (ii) the 2s² ¹S_0 - 2s2p ³P/sup o/$_1$ intersystem transition (at 264 A) in berylliumlike Fe XXIII. The measured mean lives are tau (2p ²P/sup o//sub 1/2/) = 0.55 +- 0.02, tau (2p ²P/sup o//sub 3/2/) = 0.235 +- 0.01, and tau (2s2p ³P/sup o/$_1$) = 13 +- 4 ns. Oscillator strengths derived from the Fe XXIV results are in good agreement with recent relativistic multiconfiguration Hartree-Fock (MCHF) "length" gauge calculations; the Fe XXIII result is not in agreement with these MCHF calculations, but appears to be in agreement with recent intermediate coupling calculations.

57694 Purification of helium in atomic and molecular gases by cataphoresis. Remer, D.S.; Shair, F.H. (California Inst. of Tech., Pasadena). *Chem. Eng. Prog., Symp. Ser.;* **67**: No. 112, 60-73(1971).

The separation of gas mixtures by cataphoresis in a DC glow discharge was experimentally investigated as a function of the discharge current, the total gas pressure, and the initial composition of the gas mixture. The electric field, degree of ionization, and reactor geometry were also considered. Gases under investigation included binary mixtures of helium with argon, neon, nitrogen, oxygen, carbon monoxide, and carbon dioxide. The experimental results for cataphoretic purification were interpreted within the framework of a recently proposed theory for cataphoresis involving an electrostatic Peclet number. Very good agreement was obtained between the theory and the experiment for the magnitude of the cataphoretic purification and the time for the purification. Design criteria were introduced and tested in detail to aid and facilitate the development and construction of future cataphoretic gas separator systems.

57695 Gas purification by means of cataphoresis in a radial glow dischage. Shair, F.H. (California Inst. of Tech., Pasadena). *Chem. Eng. Sci.;* **24**: 443-450(1969).

Concentration gradients have been known to occur within dc glow discharges containing various gas mixtures. This effect, resulting from one component being drawn preferentially toward the cathode, is termed cataphoresis. The theory of cataphoresis, recently developed for the traditional discharge tube geometry, has been extended to the cylindrical geometry; in the cylindrical geometry, the discharge is established within the annular space between two concentric electrodes. When the impurity ions and neutrals are tightly coupled, the reacting system is found to be equivalent to an inert system; however, the inert system is one in which the "effective" ion mobility is a product of the true ion mobility and the level of ionization of the impurity. Calculations show that cataphoresis is of practical interest only when the electrostatic Peclet number is greater than 0.1. Generally this implies that the level of ionization of the impurity must be greater than approximately 10 ppM; thus, limits are established for various operating parameters. Calculations also indicate that the characteristic time for diffusion is a weak function of the level of impurity ionization, and a strong function of geometry. Possible shortcomings of this linear model are also discussed.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 57189

57696 Resolution factors in the use of a double-pass CMA for ISS. Ellis, W.P.; Taylor, T.N. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Vac. Sci. Technol.;* **15**: No. 5, 1769-1770(Sep 1978).

A double-pass CMA with a 90° ion gun is limited for ISS by the angular-dependent ion scattering energies. A 90° +- 2.3° aperture mask significantly improves the peak resolution for He^+/Au to 2% in $\Delta E/E$ from 7% in the unmasked mode. Although surface compositions of Ni/Cu alloys were still not resolvable with Ne^+, Cu(amu 63.5) is separable from Fe(56) and As(75). As an adjunct to UPS studies, using the same analyzer, this approach is a valuable, additional capability .

57697 Charge-state dependence of electron loss from H by collisions with heavy, highly stripped ions. Olson, R.E.; Berkner, K.H.; Graham, W.G.; Pyle, R.V.; Schlachter, A.S.; Stearns, J.W. (Molecular Physics Laboratory, SRI International, Menlo Park, California 94025). *Phys. Rev. Lett.;* **41**: No. 3, 163-166(17 Jul 1978).

Theoretical calculations, confirmed by experimental measurements, are used to obtain a new scaling for electron loss from a hydrogen atom in collision with a heavy, highly stripped ion. The calculations cover the energy range 50 to 5000 keV/amu and charge states q from 1 to 50. The experiments are in the range 108 to 1140 keV/amu and charge states 3 to 22. A simple analytic expression that describes the electron-loss cross section for 1 < or = q < or = 50 in the energy range 50 to 5000 keV/amu is presented.

57698 Energy straggling of protons in carbon. Langley, R.A.; Brice, D.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). *Nucl. Instrum. Methods;* **149**: No. 1, 195-197(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

Ion backscattering from solid targets containing elements having prominent features in their scattering cross section is a new and accurate technique for measuring the energy straggling Ω of the incident particles. The 0.47 and 1.73 MeV elastic scattering resonances of protons in carbon were used to determine proton straggling. A nearly perfect graphite crystal was used to eliminate surface roughness and porosity as sources of error. In addition, measurements were made 20° off the c-axis to minimize channeling. The results are summarized by defining f = Ω/Ωsub(B), where Ωsub(B) is the straggling predicted by Bohr theory. For the 1.73 MeV resonance <f> is 0.9 +- 0.1 for Esub(p) between 0.5 and 2.1 MeV, whereas for the 0.47 MeV resonance <f> is 0.0sup(+1.5)sub(-0.0) for Esub(p) between 0.25 and 0.6 MeV, indicating the limitation of the lower energy resonance for straggling measurements.

57699 Low-energy ion beams, 1977. Stephens, K.G.; Wilson, I.H.; Moruzzi, J.L. (eds.). Bristol, Eng.; Institute of Physics (1978). 332p. (CONF-770949—). The Institute, Publishing Division-Techno House, Redcliffe Way, Bristol, England.

From International conference on low energy ion beams; Salford, UK (5 Sep 1977).

The conference on low energy ion beams included 45 papers covering ion sources, accelerator equipment, ion beam detection and applications, excitation, ionization, and charge exchange, ion beam transport, ion optics, and scattering of ion beams by surfaces. (JFP)

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 57495

57700 Calculation of the matrix shift and center of mass frequency of H_2 and D_2 dissolved in solid argon, krypton, and xenon. Vitko, J. Jr.; Coll, C.F. III. (Sandia Laboratories, Livermore, California). *J. Chem. Phys.;* **69**: No. 6, 2590-2595(15 Sep 1978).

Recent experimental and theoretical studies of H_2—inert gas dimer spectra have resulted in highly accurate Lennard-Jones pair potentials which include the effects of hydrogen bond stretching. We have used these potentials to calculate the matrix shift $\Delta\nu$ and the apparent center of mass frequency ν/sub c.m./ for H_2 and D_2 in solid Ar, Kr, and Xe. The static lattice approximation used retains the coupling between the vibrational and the translational motion of the molecule and predicts temperature-dependent values of $\Delta\nu$ and ν/sub c.m./. Comparison of our results with experiment (where available) yields satisfactory agreement.

57701 Collisional effects in the multiple infrared photon absorption in SF_6. Quigley, G.P. (University of Califronia, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Opt. Lett.;* **3**: No. 3, 106-108(Sep 1978).

At fluence levels below that for multiphoton dissociation, it is shown that for SF_6 the number of photons absorbed per molecule increases dramatically as the number of collisions with a nonabsorbing partner increases. In particular, at 70 mJ/cm², the average number of photons absorpbed per SF_6 molecule in a xenon diluent went from <3 at 1.5 Torr Xe added to more than 12 at 100 Torr (SF_6 pressure constant at 0.1 Torr).

57702 Calculation of the temperature dependence of the multiphoton absorption spectrum of SF_6. Galbraith, H.W.; Ackerhalt, J.R. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Opt. Lett.;* **3**: No. 3, 109-111(Sep 1978).

The temperature dependence of the theoretical multiphoton absorption spectrum of SF_6 gas is obtained by forming a superposition of ν_3-ladder spectra properly shifted and weighted by the vibrational Bolzmann factor for temperatures of 150 and 300 K. First-order rotational effects are included, and all levels up to three-photon absorption are contained in the model. Over 70 hotbands (95< of total population) are included at 300 K. The calculations show general brpademomg and a red shift to the absorption spectrum at room temperature, which is not, however, great enough to account for the experimentally observed dissociation-rate spectrum. We conclude that resonant absorption in the quasi-continuum occurs at or below 940 cm^{-1}.

57703 High resolution spectroscopy of the OsO_4 stretching fundamental at 961 cm^{-1}. McDowell, R.S.; Radziemski, L.J.; Flicker, H.; Galbraith, H.W.; Kennedy, R.C.; Nereson, N.G.; Krohn, B.J.; Aldridge, J.P.; King, J.D.; Fox, K. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 4, 1513-1521(15 Aug 1978).

The ν_3 bands of $^{187}Os^{16}O_4$, $^{189}Os^{16}O_4$, and $^{192}Os^{16}O_4$ have been recorded using both a Michelson interferometer (resolution 0.06 cm^{-1}) and a tunable semiconductor diode laser (resolution limited by the Doppler width, ~0.0007 cm^{-1}). The rotational fine structure differs from that of most other spherical-top molecules, for only rotational levels of A symmetry exist. A total of 112 individual vibration—rotation lines in the P and R branches of the three isotopic species were calibrated against stimulated emission lines from a high-voltage CO_2 gain cell, and were used to determine three scalar and two tensor spectroscopic constants for each species; an additional scalar constant was obtained from an analysis of the Q branch of $^{192}OsO_4$. The strength of P (11) A_2/sup ts0/ was measured for $^{192}OsO_4$ and yields a vibrational transition moment for ν_3 of 0.17 +- 0.02 D. Transitions of all isotopic species that are expected to fall near CO_2 laser lines in the region 949—972 cm^{-1} are tabulated as an aid in the interpreation of saturation spectroscopy experiments. The general quadratic symmetry and valence force constants of OsO_4 were redetermined, using the isotope shifts in ν_3 as the additional constraints for the F_2 symmetry block.

57704 Photoion angular distributions in dissociative photoionization of H_2 at 304 A. Dehmer, J.L.; Dill, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **18**: No. 1, 164-171(Jul 1978).

Photoionization of H_2 by 304-A radiation can produce the $2p\sigma$/sub u/, $2p\pi$/sub u/, and $2s\sigma$/sub g/ repulsive states of H_2/sup ts+/. The angular distributions of energetic (> 2 eV) protons from these states have been measured relative to the incident unpolarized light beam using a rotatable hemispherical electrostatic analyzer. Axial-recoil conditions apply in this situation, so that the photofragment angular distribution would be $\sin^2\theta$ for pure $\Sigma \rightarrow \Sigma$ electronic transitions and $1 + \cos^2\theta$ for pure $\Sigma \rightarrow$ Pi electronic transitions. However, unlike photodissociation processes forming neutral products, the present process also involves the ejection of photoelectrons with alternative symmetries, each associated with one of the above characteristic photoion angular distributions. Consequently, measurement of the net photoion angular distribution in dissociative photoionization yields the branching ratio between the alternative (degenerate) channels available to the photoelectron. This type of information cannot be deduced by observing the photoelectron itself. The present results indicate that the formation of the $2p\sigma$/sub u/ state H_2/sup ts+/ at 304 A is accompanied by ejection of photoelectrons with significant d-wave character.

57705 Fine structure of the triplet term of the 1s3d configuration of He I. Anisimova, G.P.; Ryzhakova, E.I.; Semenov, R.I. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 1, 10-12(Jan 1978).

The fine-structure constants of the 1s3d configuration of He I have been calculated from the experimental values of the level-crossing fields. The calculation was made according to a method based on the use of the wave functions of ruptured bonds. With the values obtained for the constants, we have calculated the quantum defect, the fine-structure intervals at zero field, and the magnitude of the singlet—triplet interaction. A comparison is made between the results obtained here and the existing experimental and theoretical data.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

57706 Measurement of energies and widths of 3d-2p transitions in light π-mesic atoms. Kir'yanov, K.E.; Marushenko, V.I.; Mezentsev, A.F.; Petrunin, A.A.; Skornyakov, S.G.; Smirnov, A.I. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 685-686(Dec 1977).

The 3d-2p transitions were studied in pionic Mg, Al, Si, and S by means of the crystal diffraction method.

57707 Polarization mechanism for nonconservation of parity and the effect of a weak neutral interaction in heavy μ-mesic atoms. Grechukhin, D.P.; Soldatov, A.A. (I. V. Kurchatov Atomic Energy Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 15-21(Jul 1977).

An estimate is made of the effect of nonconservation of parity of the 3d-orbit meson states for mesic atoms with odd nuclei in the Z=56—60 and Z~83 ranges in which the hyperfine structure terms of the $3p^3/_2$—$3d^5/_2$ and $3p^1/_2$—$3d^5/_2$ orbits respectively intersect. The angular distribution coefficient α in W $(\theta) = 1+\alpha\cos\theta$ for quanta emitted by polarized mesic atoms in the 3d→1s transition is determined. The effect of a weak neutral interaction between a muon and a nucleus and the Coulomb polarization mechanism for transferring the nonconservation of parity of nuclear states to mesic atom states in the chain of nonradiative transitions of a meson are considered. In the nuclear ranges indicated above the effect of the weak interaction for 3d- and 3p-orbits is smaller by two—three orders of magnitude than the effect of the polarization mechanism. Under optimal conditions for the intersection of $3d^5/_2$ and $3p^3/_2$ terms of a mesic atom which, as is shown, can be realized in the range Z=56—60 this mechanism leads to a value of the coefficient α which is approximately equal to the amplitude for the nonconservation of

parity for nuclear states β (I/sub ν/E/sub ν/) lying at E/sub ν/$\cong h\omega$ (3d→1s) and E/sub ν/$\cong h\omega$ (3d→2p). If dynamic amplification of the nonconservation of parity of nuclear states occurs at E/sub ν/$\cong$5—6 MeV, i.e., β (I/sub ν/E/sub ν/) $\sim 10^{-5}$, then for the quanta arising from a 3d→1s transition of a meson under real conditions for the transfer of polarization of the meson spin in the cascade of transitions populating the $3d^5/_2$-orbit the anisotropy coefficient α can attain a value of $\sim 10^{-5}$.

57708 Muon capture by deuterons and protons and the muon-nucleon coupling constants. Dogotar', G.E.; Eramzhyan, R.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 554-558(May 1977).

Experimental data concerning muon capture in hydrogen and deuterium are analyzed. Capture data for the singlet state of mesic hydrogen, the ortho state of the mesomolecular ion, and the doublet state of mesic deuterium are used to establish a range of values for the induced pseudoscalar and axial coupling constants. The results are in good agreement with the predictions of the theory of weak interactions.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 57246

57709 (AD-A—049762) Structure of multiply ionized heavy ions and associated collision phenomena. Annual report. Sellin, I.A. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). Jan 1978. Contract N00014-75-C-0474. 100p. (UTPA—7703). NTIS PC A05/MF A01.

This proposal is for continuation of the operating support of on-going research on the atomic structure of highly ionized ions and associated collision phenomenon. Experiments concerning multiply ionized ions in the range Z = 3 - 36 and as broad as possible an energy range are presently being carried out. The primary objective of our research remains the study of atomic structure of multiply ionized heavy ions and their modes of formation and destruction in collisions. Decay of excited states of these ions by radiative and also by electron emission processes is the phenomena observed in carrying out these experiments. Our principal tools are suitable sources and accelerators of multiply charged ions; x-ray, soft x-ray, and extreme ultraviolet spectrometers; electron spectrometers; lasers; on-line computer gear; and a variety of peripheral equipment associated with these devices.

57710 (ORO—5126-38) Folding potentials and the antisymmetrization. Schultheis, H.; Schultheis, R. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Apr 1978. Contract EY-76-S-05-5126. 11p. Dep. NTIS, PC A02/MF A01.

Antisymmetrization effects in the $^{16}O + {}^{16}O$ heavy-ion potential and their dependence on the nucleon-nucleon interaction have been studied. Counterexamples are given for the recent justification of folding potentials by Fleckner and Mosel in terms of a cancellation of antisymmetrization and polarization effects.

57711 Negative ion properties of fluoranil, chloranil, and bromanil: Electron affinities. Cooper, C.D.; Frey, W.F.; Compton, R.N. (Department of Physics, University of Georgia, Athens, Georgia 30602). *J. Chem. Phys.;* **69**: No. 6, 2367-2374(15 Sep 1978).

Bound and excited negative ion states of p-fluoranil (FA), p-chloranil (CA), and p-bromanil (BA) are studied from experiments involving collisions of electrons, Na, K, and Cs beams with FA, CA, AND BA. Reaction thresholds for producing FA^-, CA^-, and BA^- are determined as a function of the temperature of the target molecules. The electron affinities corresponding to 0 °K were measured to be 2.92 +- 0.2 eV for FA, 2.76 +- 0.2 eV for CA, and 2.44 +- 0.2 eV for BA. FA, CA, and BA attach ~ 0 eV electrons and FA attaches 0.5 eV electrons to form metastable parent negative ions with lifetimes in the millisecond range. These lifetimes are a function of the electron energy. Dissociative and nondissociative resonances observed via electron attachment to p-benzoquinone (PBQ) and the "anils" are correlated with the optically determined ^{2}B/sub 3g/, ^{2}B/sub 1u/, and ^{2}A/sub u/ states of PBQ^- and the anion radicals of several substituted quinones.

57712 Crossed molecular beam studies on the interaction potential for $F(^2P)+Xe(^1S)$. Becker, C.H.; Casavecchia, P.; Lee, Y.T. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **69**: No. 6, 2377-2381(15 Sep 1978).

For the evaluation of the ground state XeF interaction potential, angular distributions of F atoms scattered off Xe were measured in crossed molecular beam experiments at collision energies of 2.11, 10.5, and 13.9 kcal/mole. F atoms, produced by thermal dissociation of F_2 at 700 °C in a supersonic expansion using rare gas carriers , contain ~78% F (^{2}P/sub 3/2/) ground state and ~22% F (^{2}P/sub 1/2/) spin—orbit excited state. Consequently, three electronic states X1/2, I3/2 emerging from the ^{2}P/sub 3/2/ + $^1S_0$ asymptote, and II 1/2 from the ^{2}P/sub 1/2/+ $^1S_0$ asymptote are involved in the scattering. A simple elastic approximation, neglecting interstate coupling, is used for the calculation of differential scattering cross sections in the evaluation of interaction potentials. Experimental results are found corroborating the spectroscopically derived potential of Tellinghuisen et al. (ϵ=3.359 kcal/mole, r/sub m/=2.293A) for V/sub X/1/2(r), and the conclusion that V/sub I/3/2(r) and V/sub I/11/2(r) are in close resemblance to the ground state Ne+Xe interaction potential.

57713 Ion pair formation and atom abstraction in collisions of Cs and UF_6. Annis, B.K.; Datz, S. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **69**: No. 6, 2553-2561(15 Sep 1978).

The ion pair formation reaction $Cs+UF_6 \rightarrow Cs^+ + UF_6^-$ and the atom abstraction reaction $Cs+UF_6 \rightarrow CsF+UF_5$ have been studied over the relative kinetic energy range 0.2 to 1.3 eV using a seeded nozzle source for UF_6. The cross section for ion pair formation was found to increase with the kinetic energy and a value of 32 A^2 was observed at 1.3 eV. Unlike previous results at thermal energies, the angular distributions of CsF provided no indication of complex formation but were found to be peaked in the backward (c.m.) direction. Estimates of the abstraction reaction cross section show it to be the dominant channel in this energy range.

57714 Vibrational relaxation in the para-H_2—^{4}He system: Comparison of coupled-channel, coupled-states, and effective potential methods. Raczkowski, A.W.; Lester, W.A. Jr.; Miller, W.H. (Department of Chemistry and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **69**: No. 6, 2692-2702(15 Sep 1978).

Coupled-channel scattering calculations are performed in the energy range of 0.9 to 2.0 eV using both the Gordon—Secrest and the extended Tsapline—Kutzelnigg potentials. Vibrational relaxation rates for p-H_2—^{4}He are computed over the temperature range 50 to 2000 °K. Cross sections and relaxation rates are compared to results of coupled-states and effective potential calculations. We find quantitative agreement with coupled-states results and order-of-magnitude agreement with effective potential results. At high temperatures (around 1000 °K), relaxation rates computed using coupled-channel cross sections with both the extended TK and GS potentials agree well with experiment. At low temperatures (50 to 500 °K), the present CC—GS results lie a factor of 4 above the experimental data, while the CC—TK results are at least a factor of 10 below experiment.

57715 Crossed molecular beams kinetics: SnI and SnCl recoil velocity spectra from $Sn+CH_3I$,n-C_3H_7I, and CCl_4 and a lower limit for D^0_0(SnI). Parr, T.P.; Behrens, R. Jr.; Freedman, A.; Herm, R.R. (Ames Laboratory—USDOE and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *J. Chem. Phys.;* **69**: No. 6, 2795-2802(15 Sep 1978).

Laboratory (LAB) angular and time-of-flight (TOF) recoil velocity spectra of SnI and SnCl products formed by crossing an effusive Sn beam with CH_3I, n-C_3H_7I, and CCl_4 nozzle beams have been measured in a molecular beam apparatus equipped with an electron bombardment ionizer—quadrupole mass filter detector unit. Product center of mass (c.m.) recoil angle and energy distributions have been fit to the data by convoluting the c.m.→LAB transformation equations over measured speed distributions for both beams and the instrumental TOF response function. The $Sn+CH_3I$ and n-C_3H_7I reactions proceed via a direct interaction mechanism which favors scattering of SnI into the backward c.m. hemisphere (backward scattering denotes a reversal in Sn-atom direction during the reactive encounter). The SnCl from $Sn+CCl_4$ is scattered predominantly sideways, probably also via a direct reaction mechanism. The $Sn+CH_3I$ reaction produces a more sharply backward peaked SnI c.m. product angular distribution with higher product recoil energies than does the Sn+n-C_3H_7I reaction. All of these reaction characteristics are strikingly similar to the best experimental information which is available for the analogous alkali atom reactions. Qualitative observations are also reported on the relative reactivities of Sn with CH_3I,n-C_3H_7I, CCl_4,i-C_3H_7I, CH_3Br, CF_3Br, C_2Cl_4, and SF_6. A rigorous lower limit for the Sn—I bond energy is also established, D^0_0(SnI) > or =230 kJ/mole.

57716 Mechanism and rates of rotational relaxation of CO_2(001) in He and Ar. Preston, R.K.; Pack, R.T. (Theoretical Division, University of California Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **69**: No. 6, 2823-2832(15 Sep 1978).

Cross sections and rate constants for rotational relaxation of CO_2(001) in He and Ar are calculated using realistic (electron gas plus van der Waals) potential energy surfaces and 22 000 classical trajectories. Some propensity for small Δj transitions over large Δj transitions is noted, but there is certainly no Δj= +- 2 selection rule, and transitions with Δj as large as 30 are important in the relaxation

kinetics. Calculated rates are compared with experiment and found to be within a factor of 2 for the total rate of relaxation into a depleted level. Relaxation of levels other than the depleted level is also modeled, and it is found that the present method, in contrast to earlier models, gives excellent agreement with experiment. It is suggested that the transitions used in multiline energy extraction from CO_2 laser amplifiers be spread out rather than adjacent.

57717 Formation of small metal clusters by ion bombardment of single crystal surfaces. Garrison, B.J.; Winograd, N.; Harrison, D.E. Jr. (Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **69**: No. 4, 1440-1444(15 Aug 1978).

The mechanism for the formation of small metal clusters ejected from an ion bombarded metal surface is examined in detail. The analysis is performed by classical trajectory methods which determine the positions and momenta of all particles in a model microcrystallite as a function of time. The calculation utilizes pair potentials for Cu derived from elastic constants of the solid and is performed for 600 eV Ar^+ ion a.. normal incidence to the crystal. The results show that cluster species do not leave the surface as intact parts of the solid but form in a region above the surface. A trajectory for Cu_5 formation is traced in detail showing a typical mechanism which is valid for Cu/sub n/ formation where n< or =7.

57718 Kinetic studies of ArF^* and Ar_2F^* in proton-excited Ar—F_2 mixtures. Chen, C.H.; Payne, M.G.; Judish, J.P. (Oak Ridge National Laboratory, Oak Ridge, Tennesseee 37830). *J. Chem. Phys.;* **69**: No. 4, 1626-1635(15 Aug 1978).

A detailed neutral kinetic scheme for the production and quenching of ArF^* and Ar_2F^* is provided from time-resolved and time-integrated spectra for proton-excited Ar—F_2 mixtures at various partial pressures. The mechanism for the production of Ar_2F^* is concluded mainly from the three-body quenching of ArF^* by argon. It is also found that the efficiency to produce ArF^* by Ar_2^* (1/sub u/) with F_2 is comparable to $Ar(^3P_2)$ colliding with F_2. The two-body quenching rate constants of ArF^* and Ar_2F^* by F_2, the three-body quenching rate constant of ArF^* by Ar, and the radiative lifetime of Ar_2F^* are also obtained. The mechanism of ion—ion recombination to produce ArF^* is briefly discussed.

57719 Electron attachment to van der Waals polymers of water. Klots, C.E.; Compton, R.N. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **69**: No. 4, 1644-1647(15 Aug 1978).

Negative ions resulting from electron attachment to van der Waals polymers of water are reported. The most prominent ions observed consititute a homologous series with the stoichiometric formula $OH^-(H_2O)$/sub m/. They and the positive ions $H^+(H_2O)$/sub m/ are ascribed to ion—molecule half-reactions. The ionization of van der Waals complexes as a method for preparing "collision complexes" is discussed.

57720 Observation of oscillatory (interference) structure in the forward peak from fast-projectile electron loss. Suter, M.; Vane, C.R.; Sellin, I.A.; Elston, S.B.; Alton, G.D.; Thoe, R.S.; Laubert, R. (University of Tennessee, Knoxville, Tennessee 37916). *Phys. Rev. Lett.;* **41**: No. 6, 399-402(7 Aug 1978).

Significant unexplained oscillator structure has been observed in the wings of the forward electron-loss peak from 1.6—3.9-MeV/amu O/sup q/+ and Si/sup q/+ ions traversing Ne and Ar gases. On the basis of the observed projectile Z/sub 1,q/, and velocity and target Z_2 dependencies, this structure appears likely to arise from interference of amplitudes describing alternative channels for populating projectile-centered continuum states, conceivably including channels involving simultaneous ejection of two or more electrons.

57721 Observation of new satellites in Cs-Ar system using resonance ionization spectroscopy. Nayfeh, M.H.; Hurst, G.S.; Payne, M.G.; Young, J.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **41**: No. 5, 302-305(31 Jul 1978).

The absorption line shape of Cs-Ar system is recorded using two-photon ionization of the system with Cs(7P) as an intermediate state. New satellite structures in the wings of Cs(7P) are observed which were not resolved in previous absorption measurements. Also the absolute absorption cross section in the blue wing is measured.

57722 Bethe cross sections for the sodium isoelectronic sequence. Kim, Y.; Cheng, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **18**: No. 1, 36-47(Jul 1978).

Bethe cross sections for the excitation of Na-like ions to the 3 ^{2}P/sub 1/2/, 3 ^{2}P/sub 3/2/, 4 ^{2}P/sub 1/2/, and 4 ^{2}P/sub 3/2/ states from the ground state are computed from the relativistic Hartree-Fock wave functions. As the nuclear charge is increased, excitation cross sections to the ^{2}P/sub 3/2/ states are affected far more by relativistic effects than those to the ^{2}P/sub 1/2/ states. The asymptotic ionization cross sections for the neutral Na atom and Fe^{15+} ion are computed from a sum rule, i.e., by subtracting the sum of discrete excitation cross sections from the total inelastic-scattering cross section obtained from the sum rule. The ionization cross sections thus obtained are σ/sub ion/(Na) = $\beta^{-2}(2.51\{\ln[\beta^2/(1-\beta^2)] - \beta^2\} + 26.3) \times 10^{-20}$ cm^2, σ/sub ion/(Fe^{15+}) = $\beta^{-2}(0.209\{\ln[\beta^2/(1-\beta^2)] - \beta^2\} + 1.64) \times 10^{-20}$ cm^2, where β is the incident electron or proton speed divided by that of light. The cross section for Na is in agreement with that calculated by McGuire, but not with the electron-impact experiment by McFarland and Kinney. The ionization cross section for Fe^{15+} is a factor of 2 to 3 larger than the Coulomb-Born results by Rudge and Schwartz and by Bely in the asymptotic region.

57723 Inelastic processes leading to excited-state formation in He^+ and H^+ collisions with Na and K. Bearman, G.H.; Alspach, S.D.; Leventhal, J.J. (Department of Physics, University of Missouri at Saint Louis, Saint Louis, Missouri 63121). *Phys. Rev., A;* **18**: No. 1, 68-73(Jul 1978).

Energy partitioning among accessible product excited states has been spectroscopically studied in a beam apparatus for He^+ and H^+ collisions with Na and K atoms in the kinetic energy range 10—800 eV. The dominant observable inelastic channel in all collision systems was found to be collision-induced excitation yielding resonance radiation. While excited states of K^+ formed by charge exchange were also observed, no analogous Na^+ emissions were detected; the absence of Na^+ emissions is attributed to inefficient energy conversion. Comparison of data from one-electron and two-electron processes supports the propensity rule which states that the former are generally favored.

57724 Absolute experimental cross sections for the electron-impact ionization of Rb^+ ions. Feeney, R.K.; Sayle, W.E. II; Divine, T.F. (School of Electrical Engineering and Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Georgia 30332). *Phys. Rev., A;* **18**: No. 1, 82-84(Jul 1978).

Absolute cross sections for the single ionization of Rb^+ ions by electron impact have been measured as a function of electron energy from below threshold to approximately 2000 eV. Measurements were made in a crossed-beam facility having modulated beams. Numerous consistency checks were performed to evaluate possible sources of experimental error. Comparisons were made with other available results.

57725 Absorption of the moderate energy of an electron beam incident on silicon and gallium arsenide. Artem'ev, V.P.; Makarov, V.V. (M. I. Kalinin Polytechnic Institute, Leningrad). *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 3, 356-357(Mar 1978).

Universal dependences, describing the spatial distribution of the absorbed energy in Si and GaAs were determined experimentally from the excitation of electron-hole pairs in Al-Si and Cu-GaAs Schottky diodes bombarded with electrons of E_0=2-20 keV initial energy.

57726 Bremsstrahlung in resonant scattering in a molecular gas. Kas'yanov, V.A.; Starostin, A.N. (Moscow Energetics Institute). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 67-71(Jan 1978).

The cross section for bremsstrahlung of low-energy electrons in collisions with neutral atoms and molecules is expressed in terms of the cross sections for elastic and inelastic scattering. An explicit equation is found for the bremsstrahlung intensity for the case of resonant scattering by molecules; this equation incorporates the vibrational states of the molecules. The calculated intensities for atomic and molecular gases agree satisfactorily with experiment.

57727 Bremsstrahlung spectra of electrons at 0.4—5 keV in collisions with neutral and weakly ionized atoms. Zhdanov, V.P. (I. V. Kurchatov Institute of Atomic Energy, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 71-75(Jan 1978).

Exact, nonrelativistic, numerical calculations are carried out for the bremsstrahlung of electrons with energies 0.4—5 keV in collisions with neutral Ar, Fe, Cu, K, Mo, Ag, Xe, W, and Pb atoms and with the corresponding ions with charges of five and ten. The calculations are carried out in the static approximation by means of a partial-wave expansion. Screening is taken into account with the Thomas—Fermi potentials found through a numerical integration of the Thomas—Fermi equation.

57728 Shielded-orbital model for quasimolecule analysis of ion—atom collisions. Nikulin, V.K.; Gushchina, N.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 7-11(Jan 1978).

A method is proposed for calculating diadiabatic correlation diagrams of the orbitals of diatomic quasimolecules formed in collisions of atoms. The screening of the nuclei by the electrons in the quasimolecule is taken into account by specifying an empirical one-electron molecular potential for which separation of variables is possible for the Schroedinger equation written in spheroidal coordinates. As a result the diadiabatic correlations between the energy

levels of the separated atoms and of the composite atom are analogous to those established elsewhere for problems involving H^+_2. The calculational difficulties are the same as for the H_2^+ problem. The quasiclassical equations for the orbital energy and the separation constant of the system of coupled one-dimensional equations required for this method at small internuclear distances are derived. A procedure for specifying the parameters of the effective potential is developed. The correlation diagrams for the terms of the He^{++}—He system are calculated, and the results for certain terms are compared with existing calculations, based on interacting configurations. The results calculated for the correlation diagram of the orbitals for the Kr^+—Kr system are compared with experimental data obtained from the Auger spectra of quasimolecules.

57729 Experimental study on electron-impact excitation of spectral lines of europium. Golovchak, N.V.; Garga, I.I.; Shimon, L.L. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 1, 13-17(Jan 1978).

The effective cross sections and excitation functions of twenty-two of the most intense spectral lines of the europium atom were investigated within the 7200—2700-A spectral region, as well as the energies of the exciting electrons from the excitation thresholds to 300 eV. The observed lines are caused by the one-electron and two-electron excitation of the $6s^2$ valence electrons and also by the excitation of one of the $4f^7$ electrons. The excitation cross section values are within the 10^{-17}—10^{-19}-cm^2 interval. The influence of the mixing of the unperturbed states on the form of the excitation functions was determined.

57730 Quasiclassical approximation for the inelastic atom-molecule scattering amplitudes. Dubrovskii, G.V.; Skorodumov, A.V. (Leningrad State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 39-45(Jul 1977).

Exact expressions for the transition probability amplitudes are presented in the form of Feynman path integrals, and their quasiclassical approximations are given. The quasiclassical representations obtained for the transition amplitudes in terms of the quasiclassical action in the action-angle variables are used to study a wide range of multidimensional problems with real interaction potentials (vibrational-rotational transitions in molecules, collisions of particles with a surface, etc.). Perturbation theory techniques for finding the classical action in the cases of fast and slow collisions are developed. As examples of the solution of multidimensional problems with real interaction potentials (vibrational-rotational transitions in molecules, collisions of particles with a surface, etc.). Perturbation theory techniques for finding the classical action in the cases of fast and slow collisions are developed. As examples of the solution of multidimensional problems, analytic expressions are obtained in terms of Bessel functions for the differential cross sections for excitation of hydrogen by a charged particle and of the rotational degrees of freedom of the molecule in the $Li^+ + H_2$ collision, and also for the total cross sections for excitation of the high-lying hydrogen levels in H+H collisions.

57731 Static approximation in calculating the bremsstrahlung of electrons on atoms and ions. Zhdanov, V.P. (I. V. Kurchatov Atomic Energy Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 57-61(Jul 1977).

The use of the dipole moment, momentum, and nuclear force operators in calculating the intensity the bremsstrahlung of electrons on atoms and ions in the static approximation is analyzed. All three operators give the same value for the transition matrix element only if the disturbance of the bound electrons in the atom or ion by the incident electron is taken into account in the first order of perturbation theory. It is shown that in calculating the bremsstrahlung intensity in the static approximation the best results are obtained by using the dipole moment or momentum operator. The formal use of the nuclear force operator in static-approximation calculations does not give correct results for the emission of low-frequency bremsstrahlung photons. The limits of validity of the static approximation are discussed.

57732 Bremsstrahlung in collisions between electrons and atoms. Zon, B.A. (Voronezh State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 65-68(Jul 1977).

General formulas have been obtained which express the contribution of atomic electrons to the bremsstrahlung and absorption cross sections in electron-atom collisions in terms of the dynamic atomic polarisibility. Application of these formulas enables experimental data on the optical breakdown threshold of alkali metal vapors to be brought into qualitative agreement with the cascade theory of breakdown.

FLUID PHYSICS

57733 Numerical solution of a bubble cavitation problem. Lastman, G.J.; Wentzell, R.A.; Hindmarsh, A.C. (Department of Applied Mathematics, The University of Waterloo, Waterloo, Ontario N2L 3G1, Canada). *J. Comput. Phys.;* **27**: No. 3, 56-64(Jul 1978).

A model of a cavitating bubble, consisting of a second-order ordinary differential equation, is studied. The bubble consists of an adiabatic gas surrounded by a viscous incompressible liquid with surface tension at the liquid-gas interface. Two numerical solution methods are given, one using a regularizing transformation and the other using suitably powerful general-purpose integrators. The numerical results show that the bubble tends to return to its maximum radius on successive oscillations. This indicates that viscosity is not sufficient to account for rapid damping of bubble oscillations.

SUPERFLUIDITY

57734 Longitudinal magnetic relaxation in superfluid ^{3}He. Sager, R.E.; Kleinberg, R.L.; Warkentin, P.A.; Wheatley, J.C. (Department of Physics, University of California: San Diego, La Jolla, California). *J. Low Temp. Phys.;* **32**: No. 1, 263-300(1 Jul 1978).

Longitudinal magnetic relaxation in both ^{3}He-A and ^{3}He-B is studied in a variety of magnetic fields and three different geometries. Relaxation as described by Leggett and Takagi is observed for particular geometries in both ^{3}He-A and ^{3}He-B within a very limited range of magnetic field and temperature near T/sub c/. Under certain other conditions the longitudinal magnetization in ^{3}He-A does not relax monotonically in time. Relaxation in ^{3}He-B very near the critical temperature is shown to be remarkably different following nominal 90^0 and 180^0 pulses. Other observations using RF pulses with a time-dependent frequency provide evidence for a negative frequency shift in ^{3}He-B at large tipping angles in certain geometries.

57735 Dynamics of Onsager-Feynman vortices in a rotating superfluid system of the pulsar type. Krasnov, Y.K. (Physics Institute, Georgian Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 181-184(Jul 1977).

Equations are derived for the description of the dynamics of a vortex lattice in a rotating superfluid system of the pulsar type. The observed time dependence of the angular velocity of the normal part of the system is attributed to interaction of the system with Onsager-Feynman vortices.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

57736 (SLAC-PUB—2120) Production of leptons and lepton pairs in π/sup +-/p interactions. Mozley, R.F. (Stanford Linear Accelerator Center, CA (USA)). May 1978. Contract EY-76-S-03-0326. 15p. (CONF-780338—4). Dep. NTIS, PC A02/MF A01.

From 3. conference on new results in high energy physics; Nashville, TN, USA (6 Mar 1978).

Two low sensitivity but excellent mass resolution lepton production experiments are reported on, both performed at SLAC. One is a study of e+- production in π^{+-} interactions at 18 GeV/c performed using the SLAC hybrid bubble chamber. The other is a study of muon pair production in 15.5 GeV/c π^{+-} interactions. It is shown that electrons are due to e pairs and are not produced in anomalously large quantities, and the first model-independent evidence for a mass enhancement below the rho which is not due to Dalitz decays of known mesons. (JFP)

57737 Search for the C-noninvariant decay $\pi^0 \rightarrow 3\gamma$. Auerbach, L.B.; Highland, V.L.; Johnson, K.F.; McFarlane, W.K.; Macek, R.J.; Pratt, J.C. (Physics Department, Temple University, Philadelphia, Pennsylvania 19122). *Phys. Rev. Lett.;* **41**: No. 5, 275-277(31 Jul 1978).

A search for the three-photon decay of the neutral pion has been conducted using fast counter techniques. Such a decay would indicate a violation of charge-conjugation invariance. No excess of signal over background was observed, providing an upper limit to the branching ratio of 1.5×10^{-6} at 90% confidence level.

57738 Multipole analysis of the reaction $\gamma p \rightarrow n\pi^+$ with use of the regularization method. Miroshnichenko, I.I.; Sanin, V.M.; Shalatskii, S.V. (Khar'kov Physicotechnical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 307-310(Sep 1977).

A method is developed for regularization of the solutions of a multipole-analysis. This method is used for a multipole analysis of the $\gamma p \rightarrow n\pi^+$ reaction. The obtained solutions are stable and there are no singularities in the energy dependences of the multipoles.

57739 Photoproduction of rho⁻ mesons forward in nuclei. Anokhin, M.V.; Kanetsyan, A.R.; Nikitin, N.I.; Kharitonov, V.M. *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 515-518(May 1977).

A study is made of photoproduction of rho⁻ mesons in the forward direction in the nuclei Al, Be, C, and Cu at incident γ-ray energy up to 4.5 GeV. The measurements were made in a double-arm spectrometer. Individual channels of the production reactions were not distinguished. The experiment was simulated by the Monte Carlo method with use of the standard program FOWL (CERN) improved to increase the speed. It was found that (dσ/dt) vertical-bar/sub f/~A/sup 0.83/. This is consistent with the predictions based on the Glauber formalism for an incoherent process.

57740 Elastic scattering of γ rays by protons at energy ν< or =400 MeV. Akhmedov, D.M.; Fil'kov, L.V. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 543-547(May 1977).

An analysis of elastic γp scattering in the energy region ν< or =400 MeV is carried out on the basis of new dispersion relations for fixed t. The theoretical predictions agreee with the experimental data over the entire energy range considered except energies near the Δ (1236) resonance for an angle $\theta=90^0$. It is shown that in extraction of the proton polarizability coefficients (alpha-bar and beta-bar) from the existing experimental data on γp scattering it is important to take into account the contribution to the expansion of the cross section in ν of terms with ν/sup n/ (n> or =4). Inclusion of these terms leads to values of alpha-bar and beta-bar differing substantially from those found previously.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 57736

57741 Neutrino induced $\mu^- e^+$ events and the charm hypothesis. Bosetti, P.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.); Thomas, P.R. (California Univ., Irvine (USA)). pp 52-53 of Proceedings of the international neutrino conference Aachen 1976. Session 1: new particles. Faissner, H.; Reithler, H.; Zerwas, P. (eds.). Braunschweig, Germany, F.R.; Vieweg (1977).

From International neutrino conference; Aachen, F.R. Germany (8 Jun 1976).

It is shown that the copious production of kaons in the neutrino induced $\mu^- e^+$ events observed at Fermilab is consistent with the charm hypothesis.

57742 Measurement of the cross section for the process ν/sub μ/ + e^- → ν/sub μ/ + e^- at high energies. Cnops, A.M.; Connolly, P.L.; Kahn, S.A.; Kirk, H.G.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tanaka, M.; Baltay, C.; Caroumbalis, D.; French, H.; Hibbs, M.; Hylton, R.; Kalelkar, M.; Shastri, K. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **41**: No. 6, 357-360(7 Aug 1978).

We have observed eleven events of the reaction ν/sub μ/e^- → ν/sub μ/e^- in a sample of 106 000 charged-current neutrino interactions in a heavy neon-hydrogen mixture in the 15-ft. bubble chamber at Fermilab. We obtain a cross section for this process of [(1.8 +- 0.8) x 10^{-42} cm^2/GeV]E/sub ν/. This result is in good agreement with the prediction of the Weinberg-Salam model with $\sin^2\theta$/sub W/ = 0.2.

57743 Bounds on the diagonal leptonic coupling constant from the ITEP-IHEP and HPWF neutrino data. Asratyan, A.E.; Kubantsev, M.A. (Institute of Theoretical and Experimental Physics, State Commission on Use of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 558-560(May 1977).

The ITEP-IHEP and HPWF neutrino data are used to put upper bounds on the diagonal leptonic coupling constant.

STRONG BARYON-INDUCED INTERACTIONS

57744 Observation of structures in the pp total-cross-section difference of pure helicity states in the mass range of 2100 to 2500 MeV. Auer, I.P.; Colton, E.; Halpern, H.; Hill, D.; Spinka, H.; Theodosiou, G.; Underwood, D.; Watanabe, Y.; Yokosawa, A. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **41**: No. 6, 354-356(7 Aug 1978).

We have measured the difference between the pp total cross sections for parallel and antiparallel longitudinal spin states at beam momenta of 1.0, 1.1, 1.30, 1.58, 171, 2.1, and 2.25 GeV/c in a transmission counter experiment. These results reveal new structure in the p/sub lab/ range of 1.0 to 2.5 GeV/c.

57745 Search for long-lived heavy particles. Cutts, D.; Dulude, R.S.; Hughlock, B.W.; Lanou, R.E.; Massimo, J.T.; Brenner, A.E.; Carey, D.C.; Elias, J.E.; Garbincius, P.H.; Polychronakos, V.A.; Butler, J.; Chiaradia, M.T.; De Marzo, C.; Favuzzi, C.; Germinario, G.; Guerriero, L.; Lavopa, P.; Maggi, G.; Posa, F.; Selvaggi, G.; Spinelli, P.; Waldner, F.; Barton, D.S.; Brandenburg, G.W.; Busza, W.; Dobrowolski, T.; Duddy, T.; Friedman, J.I.; Halliwell, C.; Kendall, H.W.; Lyons, T.; Nelson, B.; Rosenson, L.; Tartaglia, M.; Verdier, R.; Young, C.C.; Nassalski, J.; Siemiarczuk, T. (Brown University, Providence, Rhode Island 02912). *Phys. Rev. Lett.;* **41**: No. 6, 363-367(7 Aug 1978).

We have performed high-sensitivity search for massive long-lived particles produced at 2.5 mrad by 400-GeV/c protons on a beryllium target using time-of-flight, Cherenkov, and calorimetric techniques. A total of 10^{11} light particles (π^-,K^-,p-bar) was sampled at 70 KeV/c. The experiment places a limit of 1.1 x 10^{-37} cm^2/$(GeV/c)^2$ nucleon on the invariant cross section for the production of stable particles in the mass range of 4 to 10 GeV/c^2.

57746 Search for direct electron production in p-p and p-Be collisions at 12 GeV/c. Makdisi, Y.; Marshak, M.L.; Peterson, E.A.; Ruddick, K.; Klem, R.; Miller, R.J.; Roberts, J.B.; Price, L.E. (University of Minnesota, Minneaplis, Minnesota 55455). *Phys. Rev. Lett.;* **41**: No. 6, 367-370(7 Aug 1978).

We have made a systematic search for direct e^+ and e^- production in p-p and p-Be collisions at 12 GeV/c incident proton momentum. Data were collected at c.m. angles of 20^0, 35^0, 63^0, and 84^0. We find no evidence for the previously reported rise in the ratio e/π at low momentum transfer. The data are consistent with zero direct electron production from other than previously known sources.

57747 Projectile dependence of multiparticle production in hadron-nucleus interactions at 100 GeV/c. Elias, J.E.; Busza, W.; Halliwell, C.; Luckey, D.; Votta, L.; Young, C. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **41**: No. 5, 285-287(31 Jul 1978).

Average multiplicities and pseudorapidity distributions for 100-GeV/c p-, K^+-, and π^+-nucleus collisions are presented. The average multiplicities increase with nuclear thickness. The fractional increase is independent of incident particle species, provided that nuclear thicknesses are calculated in units of mean free path of the incident hadron. This scaling behavior suggests that the immediate product of a hadron-nucleon collision is a state similar to the incident hadron.

57748 Regge analysis of the differential cross sections for elastic scattering at large momentum transfers. Potashnikova, I.K. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 674-679(Dec 1977).

The differential cross sections for elastic scattering of π^{+-}, K^{+-}, p, and p-bar by protons have been measured [C. Bruneton et al., Proc. of the 18th Intern. Conf. on High Energy Physics, Tbilisi, 1976, paper No. 811] at 40 GeV/c for negative particles and at 45 GeV/c for positive particles. The purpose of the present paper is to analyze these results and previous data on the differential cross sections at energies on the basis of a Regge model.

57749 Inelastic diffractive scattering of protons and π^+ mesons by protons at initial momenta of 42.5 and 52.2 GeV/c. Apokin, V.D.; Vasil'ev, A.N.; Derevshchikov, A.A.; Matulenko, Y.A.; Meshchanin, A.P.; Mysnik, A.I.; Nurushev, S.B.; Saraikin, A.I.; Siksin, V.V.; Smirnov, E.V.; Solov'ev, L.F.; Solov'yanov, V.L.; Chuiko, B.V. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 299-302(Sep 1977).

Differential cross sections for inelastic scattering of protons and positive pions by protons have been measured; the measurements were made in the intervals $0.002<p^2$/sub t/<0.026 $(GeV/c)^2$ and $3.6<M^2$/sub X/<7.4 GeV^2 for 42.5-GeV/c incident protons and pions and in the intervals $0.002<p^2$/sub t/<0.042 $(GeV/c)^2$ and $4.2<M^2$/sub X/<9.5 GeV^2 for 52.2-GeV/c incident protons. The data are discussed in terms of the triple-Reggeon model. Evidence is found that the PPP contribution is small at momentum transfers close to zero.

57750 Relative yields of hadrons with large transverse momenta in interactions between 70-GeV protons and Be or Cu nuclei. Akimenko, S.A.; Belousov, V.I.; Blik, A.M.; Golovnya, N.I.; Kut'in, V.M.; Solov'ev, A.S. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 302-303(Sep 1977).

We measured the relative yields of π^+ and K^+ mesons and of protons produced in interaction between a 70-GeV proton beam and Be or Cu nuclei in the region of large transverse momenta (p/sub perpendicular/>1 GeV/c). The measurement results point to scale invariance of the relative kaon yields as functions of x/sub perpendicular/.

57751 Diffraction excitation of protons on protons and deuterons at high energies and small momentum transfers. Mukhin, S.V.; Tsarev, V.A. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 403-430(Sep 1977).

The results are presented of measurements of the cross sections of diffraction dissociation of protons on hydrogen and deuterium made with the Dubna jet target at the Fermi National Accelerator Laboratory in the United States. Theoretical models of diffraction dissociation are discussed and compared with experiment.

57752 Measurement of the depolarization parameter D in pp scattering at 1000 MeV. Vovchenko, V.G.; Zhdanov, A.A.; Zheleznyakov, V.M.; Kazarinov, Y.M.; Komarov, E.N.; Polyakov, V.V.; Fedorov, O.Y.; Shvedchikov, A.V.; Yazikova, S.V. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 519-522(May 1977).

An experimental setup using a polarized proton beam for measuring the Wolfenstein parameter D in pp scattering at E/sub p/ =965 MeV is discussed. The asymmetry A_2, the polarization P_2, and the parameter D have been measured at c.m. scattering angles of 40, 90,110,120, and 135° for 965-MeV protons. The measured values of D are compared with values measured at other energies and with the results of preliminary phase-shift analyses in the vicinity of 1000 MeV.

57753 Some characteristics of distributions in rapidity gaps in pp interactions at 69 GeV/c. Bogolyubskii, M.Y.; Boratav, M.; Jabiol, M.A.; Derre, J.; Bumazhnov, V.A.; Ermolov, P.F.; Kistenev, E.P.; Moiseev, A.M.; Pauli, E.; Touchard, A.N. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 527-530(May 1977).

We report a study of the rapidity gaps between charged particles ordered on a scale of rapidities in the reactions $pp \to \pi_1 + \pi_2 + X$, $pp \to \pi^-{}_1 + \pi^-{}_2 + X$, $pp \to \pi^+{}_1 + \pi^+{}_2 + X$. It is shown that the semi-inclusive distributions dσ/sub n//dr are satisfactorily described by the simple exponential dependence exp (-λr), the slope λ increasing with increase of multiplicity. We present an analysis of the correlations between gaps. It is shown that in the central region in events of high multiplicity there are positive correlations both between neighboring gaps and between gaps separated by two and three charged particles.

STRONG MESON-INDUCED INTERACTIONS

57754 Production of J/psi particles in π^-N interactions at 27 and 40 GeV/c. Bushnin, Y.B.; Golovkin, S.V.; Denisenko, A.A.; Dzhelyadin, R.I.; Dunaitsev, A.F.; Zaitsev, A.M.; Konoplyanikov, A.K.; Konstantinov, V.F.; Kubarovskii, V.P.; Landsberg, L.G.; Leont'ev, V.M.; Mukhin, V.A.; Obraztsov, V.F.; Petrunina, T.I.; Pokrovskii, N.S. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 642-645(Dec 1977).

Data are reported on production of J/psi particles in the inclusive process π^- +Cu nucleus $\to$J/psi+... at momenta 27 and 40 GeV/c, obtained in the Lepton apparatus. Total cross sections for production of J/psi particles are found to be Differential distributions for the process studied are presented as a function of the kinematics variables x and p^2/sub perpendicular/. Attention is called to the peak in the distribution in x in the region x$\gtrsim$0.3.

57755 Investigation of the $K^-p \to \bar{K}^0 n$ reaction at 25 and 40 GeV/c. Apel, W.D.; Bertolucci, E.; Viktorov, V.A.; Vincelli, M.L.; Donskov, S.V.; Inyakin, A.V.; Kachanov, V.A.; Krasnokutskii, R.N.; Kronsteiner, R.; Leder, G.; Ledner, A.A.; Mannelli, I.; Mikhailov, Y.V.; Mueller, H.; Pernicka, M.; Prokoshkin, Y.D.; Prokhorov, A.N.; Pierazzini, G.M.; Sergiampietri, F.; Sigurdsson, G.; Scribano, A.; Toropin, A.N.; Schneider, H.; Shuvalov, R.S. (Joint experiment: Institute of High Energy Physics (IHEP), Serpukhov, USSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 645-649(Dec 1977).

Differential cross sections for the charge-exchange scattering of K^- mesons by protons have been measured at 25 and 40 GeV/c by a method that does not involve the use of a magnetic field. The reaction cross section is proportional to P/sup -1.52/ in the incident-momentum interval 5<P<40 GeV/c. The differential cross section has a dip at small momentum transfers (-t< or $\simeq m^2$/sub π/) similar to the one previously observed at lower energies. The forward (t=0) differential cross sections are considerably smaller than predicted by the Regge-pole model. The parameters of the effective trajectory are determined.

57756 Inelasticities and energy-separated (high-momentum) particles in pion-nucleus interactions at 50 GeV/c. Anon(Alma-Ata—Dubna—Leningrad—Moscow—Tashkent Collaboration). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 653-655(Dec 1977).

Nuclear emulsions in a strong magnetic field have been used to investigate the characteristics of energy-separated (high-momentum, p>0.1 p_0) charged particles (ESCP) in several groups of π^--nucleus interactions (πN, N/sub n/< or =6, and N/sub h/> or =7 interactions) at 50 GeV/c. Distributions and average fractions of the energy carried off by positive and negative relativistic particles and by neutral particles have been obtained and the investigated quantities have been examined as functions of the multiplicity n/sub s/ and the target-nucleus mass number A. All the interaction groups showed more negative ESCP per star than positive ones. The number of positive ESCP is independent of A (within the experimental error). The π^-N interactions have roughly twice as many negative ESCP per event as the N/sub h/> or =7 interactions; this indicates that the leading π^- mesons suffer repeated interactions within the nucleus. The total energy carried off by all relativistic charged particles, as well as by all neutral particles, is independent of A, but the partial inelasticities K /sub(+/) and K/sup prime/ /sub(-/) (excluding the leading particle) show a weak A dependence (proportionalA/sup α/ with α=0.05 +- 0.01).

57757 Analysis of angular distributions of secondary shower particles in inelastic pion-nucleus collisions at 200 GeV. Anon(Alma-Ata—Gatchina—Moscow—Tashkent Collaboration). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 656-659(Dec 1977).

The basic characteristics (shape, averages, dispersions, etc.) of single-particle angular distributions of shower particles and their dependence on multiplicities of various types of particles have been studied in the π^-A collisions at 200 GeV/c. A qualitative comparison is made between the data and a series of popular models of hadron-nucleus collisions.

57758 Determination of nucleon and pion form factors by analyzing the reaction $\pi^-p \to e^+e^-n$ at 275 MeV. Berezhnev, S.F.; Blokhintseva, T.D.; Dem'yanov, A.V.; Kuptsov, A.V.; Kurochkin, V.P.; Nemenov, L.L.; Smirnov, G.I.; Khazins, D.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 290-293(Sep 1977).

The isovector nucleon form factor F/sup V/$_1$ and the π-meson form factor F/sub π/ are found by analyzing the angular distributions from the reaction $\pi^-p \to e^+e^-n$ for nine values of the four-momentum transfer in the range from 1.5 to 3.0 F^{-2}. The corresponding electromagnetic radii are obtained. A phenomenological analysis of the reaction has given a model-independent way of determining the contributions to the inverse pion electroproduction cross section from states with different virtual photon polarizations. The photon scattering angle for which the reaction cross section is given by only Born terms is estimated.

57759 Single-particle correlations in semi-inclusive pion-nucleon reactions at p=40 GeV/c. Angelov, N.; Batskovich, S.; Grishin, V.G.; Dzhmukhadze, S.V.; Didenko, L.A.; Ivanovskaya, I.A.; Inogamova, T.Y.; Kanarek, T.; Kladnitskaya, E.N.; Lyubimov, V.B.; Lyutov, S.I.; Mel'nikova, N.N.; Nad, Y.; Nazargulov, R.M.; Nikitina, V.F.; Popova, V.M.; Solomin, A.N.; Semerdzhiev, K.; Solov'ev, M.I.; Suleimanov, M.K.; Tuvdendorzh, D.; Fadeev, N.G.; Tsivtsivadze, E.T.; Shklovskaya, A.I.; Shcheglova, L.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 294-299(Sep 1977).

Semi-inclusive structure functions of π^{+-} mesons and γ quanta are studied as functions of transverse momentum (p/sub perpendicular/) and of the longitudinal variables Y* and x (= 2p*/ sub parallel//$\sqrt{s}$). Characteristics of the particle distributions with respect to the longitudinal variables are analyzed as functions of secondary charged-particle multiplicity (n/sub c/h) and of the transverse momentum. In π^-N interactions at p=40 GeV/c dynamical correlations are found between mean values of the transverse momentum of the secondary particles and their longitudinal variables.

57760 Analysis of partial and topological cross sections for π^-p interactions at 5 GeV/c. Amaglobeli, N.S.; Budagov, Y.A.; Vinogradov, V.B.; Volod'ko, A.G.; Lomakin, Y.F.; Rumyantsev, V.S.; Salukvadze, R.G.; Flyagin, V.B.; Shandor, L.; Shoshiashvili, S.S. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 523-526(May 1977).

A complete set of partial and topological cross sections of π^-p interactions at 5 GeV/c is obtained and on the basis of it the multiplicity distributions of π^0 mesons and charged particles and also the total multiplicity distribution of secondary particles are constructed. The parameters of the multiplicity distributions of different types of secondary particles are calculated. It is shown that the multiplicity distribution of π^0 mesons agrees with the Poisson distribution. Correlations in the yields of π^+, π^-, and π^0 mesons are analyzed.

57761 Momentum and angular characteristics of diffraction and nondiffraction π^-p interactions at momentum 40 GeV/c. Grishin, V.G.; Kerachev, P.P.; Tsivtsivadze, E.T. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 531-533(May 1977).

Distributions of π^{+-} mesons and γ rays in longitudinal rapidity and transverse momenta in diffraction and nondifraction π^-p interactions are presented for p=40 GeV/c. Topological cross sections have been determined, and also the dependence of the average multiplicity of π/sup O/ mesons on the number of secondary charged particles in diffraction interactions. The momentum and angular characteristics of the two types of interactions are discussed.

57762 Energy and angular distributions of secondary charged particles from interactions of 50-GeV π^- mesons with nuclei. Anon(Alma-Ata—Dubna—Leningrad—Moscow—Tashkent Collaboration). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 533-536(May 1977).

Single-particle inclusive distributions of π^- and π^+ mesons from collisions of 50-GeV/c π^- mesons with nuclei have been investigated, using nuclear emulsions in a strong magnetic field. The longitudinal distributions shift and become deformed as the number of intranuclear collisions increases; the leading-particle effect persists, but the leading particle undergoes repeated interactions. The transverse-momentum distributions are weakly A-dependent. An indication was found that the fast "preserved" and "produced" particles behave differently within the nucleus. The results are compared with results obtained by similar methods for π^-N, pN, and pA collisions.

57763 Multiplicity of charged secondary particles in π^--^{12}C interactions at 40 GeV/c. Angelov, N.S.; Batskovich, S.; Grishin, V.G.; Lyubimov, V.B.; Nad', Y.; Suleimanov, M.; Tuvdendorzh, D. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 537-538(May 1977).

Distributions of π^--^{12}C interactions are presented as functions of the number of charged secondary particles. Events with the total charge Q=-2, -1, 0, +1, +2, +3, +4 of all charged particles (except protons with p/sub lab/< or ≈0.7 GeV/c) are studied.

57764 Interactions of π^- mesons with carbon nuclei at 40 GeV/c. Anon(Budapest—Bucharest—Dubna—Krakow—Sofia—Tbilisi—Tashkent—Ulan Bator—Hanoi Collaboration). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 539-542(May 1977).

Momentum and angle distributions of π^+ and π^- mesons, obtained by investigating about 3400 events of π^- interaction with the carbon nucleus at 40 GeV/c, are presented. The π^+ and π^- spectra differ due to the presence of leading negative pions. The ratio of the structure functions for π^-N and π^--^{12}C interactions at equal energies is analyzed as a function of the variable x=p*$_{11}$/p*/sub max/.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

57765 Local currents in dual string theory. Liskova, N.A. (Leningrad State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 679-685(Dec 1977).

The local interactions of strings with an external scalar current are considered in the framework of the Nambu dual string model as interactions mediated by virtual states of a closed pointlike string. The amplitude for the interaction of such a current with an arbitrary number of strings with free ends in ground states is presented. The asymptotic properties of a ground-state open-string form factor are investigated for large momentum transfers. The amplitude for the interaction of a local current with an arbitrary number of closed ground-state strings is obtained.

ELECTROMAGNETIC INTERACTIONS

57766 Two-fireball model of e^+e^- annihilation into hadrons at high energies, and the jet problem. Gorenshtein, M.I.; Zinov'ev, G.M.; Petrov, V.K. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 310-314(Sep 1977).

The energy spectrum and angular distribution of secondary particles in the reaction e^+e^-→hadrons were calculated in a model with two moving fireballs. The model leads to hadron production in the form of two symmetrical jets whose parameters agree with the experimental data.

57767 Double bremsstrahlung. Smirnov, A.I. (Kostroma State Pedagogical Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 548-550(May 1977).

The differential cross section for double bremsstrahlung produced in the scattering of an electron in the Coulomb field of a nucleus is calculated. The calculation is done using the Feynman method without considering the polarizations of the particles. Different kinematic variants of the process are investigated for nonrelativistic and extreme relativistic energies of the incident electron.

WEAK INTERACTIONS

57768 Trimuons from charm. Young, B.L. (Ames Lab., Iowa (USA)); Walsh, T.F.; Yang, T.C. (Massachusetts Univ., Amherst (USA)). *Phys. Lett., B;* **74**: No. 1, 111-114(27 Mar 1978).

Charm pair production in ν/sub μ/N collisions has been calculated using quantum chromodynamics (QCD). The resulting trimuon rate turns out to be small at present energies: sigma(3μ)/sigma(1μ) < or approximately = 10^{-6} at E/sub γ/ = 200 GeV for α/sub s/ = 0.2. (However, this process may be measurable at the high energies attainable with colliding beam ep machines.) The general importance of looking for inclusive J/psi or the bound states of heavier flavors in deep inelastic reactions as a signal for the pair production of heavy quarks is emphasized.

57769 Effects of the transition magnetic moment of the neutrino. Kim, J.E. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev. Lett.;* **41**: No. 6, 360-363(7 Aug 1978).

It is shown that a sizable transition magnetic moment between ν/sub μ/ and a massive neutrinos ν' (of mass of approximately 100 MeV) leads to some detactable effects. These effects could be revealed significantly in ν/sub μ/ - (nu-bar/sub μ/$^-$) electron scattering, but would remain hidden in most other cases. It is also pointed out under what circumstances a large transition magnetic moment arises in gauge models.

57770 How many neutrinos. Ma, E.; Okada, J. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Phys. Rev. Lett.;* **41**: No. 5, 287-289(31 Jul 1978).

Measurement of e^+e^- → $\gamma\nu$nu-bar at the new colliding-beam facilities can determine directly the total number of neutrino types (ν/sub e/,ν/sub μ/,ν/sub tau/, etc.).

57771 Electromagnetic corrections to deep inelastic μp scattering at high energies. Akhundov, A.A.; Bardin, D.Y.; Shumeiko, N.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 660-663(Dec 1977).

Electromagnetic corrections to deep inelastic μp scattering at muon energies E=50—250 GeV are calculated. The structure functions are taken from the latest analysis of the world data on electroproduction of hadrons in the resonance and deep inelastic regions (E<20 GeV), extrapolated into the high-energy region. Over most of the kinematic region, the corrections are found to be insensitive to the way in which the structure functions are fitted.

57772 Inclusive reaction e^+e^-→VX with allowance for the polarization states of the produced vector meson. Khachatryan, G.N.; Shakhnazaryan, Y.G. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 664-668(Dec 1977).

A study is made of the inclusive process e^+e^-→VX with allowance for the polarization states of the vector meson. A tensor describing the vertex for the transition γ^*→VX, containing in general eight structure functions, is constructed. The helicity representation is used to calculate the elements of the density matrix for the produced vector meson, which are expressed in terms of these structure functions and the polarization vectors of the annihilating particles. It is shown that only six structure functions can be determined by studying the angular distribution of the products of the decay of the vector meson into pseudoscalar particles (rho→2π, ω →3π, phi→2K), since the polarization vector of the vecton does not contribute to these decays. A determination is also made of the angular distribution of the longitudinally polarized leptons in the decay V→1^+1^- (psi, psi'→1^+1^-), from which it follows that all the structure functions can be distinguished in this case. To do this, it is necessary that the polarization vectors of the annihilating electron or positron have a longitudinal component and that the longitudinal polarization of at least one of the decay leptons is measured.

57773 Vector-like weak currents and parity violation in neutral transitions. Babaev, Z.R.; Zamiralov, V.S. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 668-670(Dec 1977).

It is shown that the observed parity violation in neutral weak interactions can be explained in the framework of the SU (6) model of vector-like weak currents. The resulting solution imposes strong constraints on the character of the interactions of heavy quarks.

57774 Elastic scattering of low-energy neutrinos by atomic systems. Gaponov, Y.V.; Tikhonov, V.N. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 314-318(Sep 1977).

A study is made of the elastic scattering of low-energy neutrinos by atomic systems. In the case of the V variant of the weak interaction the scattering takes place coherently on the entire system (of electrons, protons, and neutrons), whereas in the case of the A variant the scattering takes place coherently on the shell electrons and on the nucleons of the nucleus separately. The coherence effect is illustrated for the simplest atomic systems. The result is given for an arbitrary atom. The analysis shows that for neutrino energies < or ≈10 keV there is a region of coherent optical neutrino effects in which the dominant processes involve elastic scattering of the neutrino by the atom as a whole.

57775 Effect of second-class currents on the differential cross sections for quasi-elastic ν/sub μ/(nu-bar/sub μ/) N. Korotkov, V.A.; Kuznetsov, E.P.; Makeev, V.V.; Nikitin, Y.P. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 318-320(Sep 1977).

Recent experimental data on the total cross sections for quasi-elastic ν/sub μ/n and nu-bar/sub μ/p scattering are used to obtain more stringent bounds on the contribution from second-class weak hadronic currents. The previously known upper bound on the contribution from these currents is reduced by about a factor of 2. It is argued that the existing bounds on second-class currents can be significantly improved by studying the differential cross sections for quasi-elastic neutrino (antineutrino) reactions for large values of the square of the 4-momentum transfer ($q^2 >$ or $= 1$ (GeV/c)^2).

57776 Production of hadrons with new quantum numbers in ν/sub μ/(nu-bar/sub μ/) N interactions. Konoplich, R.V.; Kuznetsov, E.P.; Nikitin, Y.P.; Sokolov, A.A. (Moscow Engineering Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 321-326(Sep 1977).

A quark-parton model for the production of unusual hadrons in ν/sub μ/(nu-bar/sub μ/) N interactions is proposed. It is shown that the existing experimental data are in agreement with the predictions of the model for heavy-hadron masses m≈2—3 GeV. A model-independent correlation between the transverse momentum p/sub perpendicularl/ of the lepton from the decay of an unusual hadron and the mass m of this hadron is obtained. The correlation between p/sub perpendicularl/ and m can be used both to identify the production of the hadron X and to determine its mass.

57777 Right-handed weak currents and "direct" neutrinos. Volkov, G.G.; Kuznetsov, E.P.; Nikitin, Y.P. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 327-329(Sep 1977).

The possible existence of unusual neutrino sources that decay into a right-handed (muon or electron) neutrino and a heavy lepton is considered. A gauge scheme for the weak interaction involving eight leptons and eight quarks is studied. This scheme is used to account for the origin of the direct leptons and to predict the existence of right-handed neutrinos. The prospects of detecting unusual neutrinos in accelerator experiments using a method proposed by Pontecorvo (Zh. Eksp. Teor. Fiz. 69, 452 (1975) [Sov. Phys. JETP 42, 229 (1975)]; Usp. Fiz. Nauk 104, 3 (1971) [Sov. Phys. Usp. 14, 235 (1971)]) are evaluated.

57778 Weak interaction and the quark-parton model with the strong interaction of quarks taken into account phenomenologically. Folomeshkin, V.N. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 329-332(Sep 1977).

A variant of the quark-parton model with (V-κA) interaction and R=σ/sub L//σ/sub T/ not =0 is considered. Various sum rules for the structure functions are written down.

57779 Neutrino interactions and six-quark models. Alekseev, A.I.; Tikhonin, F.F. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 332-336(Sep 1977).

Possible types of right-handed hadronic currents in six-quark models are investigated. The method for finding them is a direct generalization of the approach used by G. G. Volkov, A. G. Liparteliani, and F. F. Tikhonin (ZhETF Pis. Red. 22, 523 (1975) [JETP Letters 22, 255 (1975)]) for the four-quark model. In each of the models of the present case there is a considerably larger number of right-handed currents than in the SU (4) model. There are seven in the Harari model, six in the Barnett model, and six in the Close-Colglazier model. The currents obtained were used to calculate various distributions in neutrino reactions. The numbers of currents that are in agreement with the available experimental data are one for the Harari model, two for the Barnett model, and all six for the Close-Colglazier model.

57780 Weinberg-Salam model and weak radiative decays of K/sub L/ mesons. Malakyan, Y.P. (Institute of Physical Research, Academy of Sciences of the Armenian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 337-341(Sep 1977).

The weak radiative decays K/sub L/→2γ and K/sub L/ →$\pi^+ \pi^- \gamma$ are considered in the Weinberg-Salam weak-interaction model and in the framework of an asymptotically free gauge theory of strong interactions. The problem of calculating short-distance and long-distance decays is discussed. It is shown that only long-distance contributions that can not be calculated exactly are essential. It is, however, possible to use the anomalous PCAC theory to derive a relation connecting the long-distance contributions to these two reactions and hence also their decay amplitudes with known constants. The obtained relation is confirmed by experimental data.

57781 Weak interaction of colored hadrons. Anpilova, T.E.; Babaev, Z.R.; Zamiralov, V.S. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 550-553(May 1977).

A general expression is constructed for the weak hadronic current in the colored-quark model with SU (3) x SU (3) ' symmetry. It is shown that there exist several different solutions for which it is possible to suppress neutral currents with changing strangeness. An additional peculiarity of the model is the presence of $\Delta Q = 2$ transitions which also result in diagonal neutral currents.

57782 Interpretation of the CERN neutrino data on the νN (nu-bar N) total cross sections. Folomeshkin, V.N. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 560-562(May 1977).

It is shown that, if allowance is made for the non-zero value of R=σ/sub L//σ/sub T/ in electroproduction processes, the naive quark-parton model cannot account for the data of the CERN neutrino experiment and of experiments on electron-nucleon scattering.

STRONG INTERACTIONS, GENERAL

57783 Possible type of dynamical symmetry breaking in the dual resonance model. Laperashvili, L.V. (Institute of Physics, Georgian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 347-349(Sep 1977).

An analysis is given of the possibility of complete renormalization of the meson Regge trajectories of a dual resonance model in which the higher orders of perturbation theory lead to Brower-Goddard trajectories with intercept $\alpha_0 >$ or $= 3$.

57784 Effect of vacuum cuts in the asymptotes of inclusive cross sections in the case of weak coupling. Abramovskii, V.A. (Physics Institute, Academy of Sciences of the Georgian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 562-565(May 1977).

An upper bound to the magnitude of the three-Pomeron vertex is obtained for the case of weak coupling.

STRONG INTERACTIONS, BARYON NO.=0

57785 Measurement of the $\pi^+ \pi^- \rightarrow$ K/sub s/^{0}K/sub s/^{0} scattering cross section. Cason, N.M.; Baumbaugh, A.E.; Bishop, J.M.; Biswas, N.N.; Kenney, V.P.; Polychronakos, V.A.; Ruchti, R.C.; Shephard, W.D.; Watson, J.M. (University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev. Lett.;* **41**: No. 5, 271-274(31 Jul 1978).

Data from the reaction $\pi^- p \rightarrow$ nK/sub s/^{0}K/sub s/^{0} have been used to determine the cross section for the reaction $\pi^+ \pi^- \rightarrow$ K/sub s/^{0}K/sub s/^{0} by extrapolation to the pion pole. The reaction $\pi^+ \pi^- \rightarrow$ K/sub s/^{0}K/sub s/^{0} is dominated by S* and f^0 production. The $\pi^+ \pi^- \rightarrow$ K/sub s/^{0}K/sub s/^{0} cross section is well below the S-wave unitarity limit in the S* (threshold) region. We discuss implications for the SU(3) scalar meson nonet and for $\pi\pi$ phase-shift analyses.

57786 Values of the etacc-bar and eta'cc-bar coupling constants. Voloshin, M.B. (Institute of Theoretical and Experimental Physics, State Atomic Energy Commission). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 576-578(May 1977).

The widths of the decays psi→etaγ and psi→eta'γ are used to calculate the pseudoscalar coupling constants for the interaction of eta and eta' mesons with c quarks. It is shown that the emission of an eta meson by the c quark as a result of this interaction gives a negligible contribution to the decay psi'→psieta. A theoretical estimate of the etacc-bar and eta'cc-bar coupling constants is also obtained on the basis of quark-gluon diagrams. The results of the theoretical calculation are in agreement with phenomenological estimates.

STRONG INTERACTIONS, BARYON NO.=1

57787 Quarks as quasiparticles of bound states. Tyapkin, A.A. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 670-673(Dec 1977).

A treatment of quarks as strongly bound subsystems of the baryon structure is considered, with the baryons assigned to various states with integers Q and B. The requirement that the appropriate fractional values of the quantum numbers of the quarks be obtained, and that appropriate integral values be obtained for the whole system of three bound quarks, uniquely determine the three initial states of the quarks, labeled by the set of values of the quantum numbers Q, B, and J. In this connection the new color quantum number is interpreted as a quantity which characterizes the presence of the subsystems in different eigenstates. The self-consistency of the changes of color states in the three-quark system is explained on the basis of a generalized Sakata model.

57788 Double charge exchange of pions in inclusive reactions at high energies. Kopeliovich, B.Z.; Tseren, C. (Joint Institute for

Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 341-347(Sep 1977).

Inclusive processes with double charge exchange of pions are considered in the hard part of the momentum spectra. The calculations have shown that, in contrast to binary reactions, the contribution of the branch points is negligible and the principal role is played by resonance production.

57789 Asymptotic power-law scaling of large-angle hadron-hadron scattering. Goloskokov, S.V.; Kuleshov, S.P.; Matveev, V.A.; Smondyrev, M.A. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 395-402(Sep 1977).

Some results obtained in the framework of the quasipotential approach for large-angle high-energy hadron scattering are reviewed.

57790 Description of low energy πN scattering in nonlinear SU (2) x SU (2) chiral dynamics. Gaisak, M.I.; Lend'el, V.I. (Institute of Theoretical Physics, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 452-463(Sep 1977).

The present state of the theory of low energy πN scattering is reviewed. It is shown that the use of a nonlinear SU (2) x SU (2) chiral invariant Lagrangian in the exponential parametrization, the superpropagator method of regularizing the scattering amplitude, and the Pade approximation enables one to obtain a dynamical description of low energy πN scattering without the introduction of any arbitrary parameters. From the first two nonvanishing terms in the perturbation series, analytic expressions are obtained in the diagonal (1,1) Pade approximation for the s and p partial-wave amplitudes. The energy dependence and position of the s- and t-channel singularities of the πN scattering amplitude are in very satisfactory agreement with the experimental data.

57791 Description of πN scattering in terms of the generalized reaction matrix. Edneral, V.F.; Troshin, S.M.; Tyurin, N.E. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 569-572(May 1977).

An analysis is made of πN scattering in the IHEP and FNAL energy regions in terms of the generalized reaction matrix. Good agreement with the existing experimental data is obtained. Predictions are given for the polarization in elastic scattering and in the charge-exchange reaction.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

57792 Coherent production of pions in collisions of relativistic nucleons with nuclei. Zaretskii, D.F.; Lomonosov, V.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 639-642(Dec 1977).

The transitional and Cerenkov production of pions in collisions of relativistic nucleons with nuclei is considered. Angular and spectral distributions of the produced pions are estimated.

57793 Determination of the cross section for interaction of an unstable system of three π mesons with a nucleon from analysis of the A and t' dependences of the diffraction dissociation process. Dolinov, V.K.; Ermekov, N.T.; Zaimidoroga, O.A.; Korotkikh, V.L. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 649-652(Dec 1977).

The theory of coherent and incoherent processes is used for analysis of the data on diffraction production of a three-pion system in nuclei at 15 GeV/c. As the result of a combined fit of the differential cross sections for coherent and incoherent processes, a rise is obtained for the total cross section for interaction of the 3π system with a nucleon on increase of its effective mass.

57794 Inelastic interactions of hadrons with nuclei. Gedalin, E.V. (Institute of Physics, Georgian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 285-289(Sep 1977).

Consistent application of the Reggeon cutting rules makes it possible to construct a Reggeon field theory taking into account all possible rescattering events of cut and uncut Reggeons. Explicit expressions for the inclusive cross sections are obtained in the quasi-eikonal approximation for rescattering of external particles. It is shown that in the tree-graph approximation the density fluctuations for particles produced in interactions of fast hadrons with nuclei are high for rapidities near the fragmentation region of the nucleus, where the particle density is also high.

57795 Inclusive Σp and pp reactions. How can one explain the nature of π, K, Λ, and N exchange and determine the coupling constants. Vasylev, A.M.; Ginzburg, I.F.; Perlovskii, L.I. (Mathematics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 573-576(May 1977).

Inclusive experiments $pp \to \pi^+ + \ldots$, $\Sigma p \to \Lambda + \ldots$, $pp \to K^+ + \ldots$, ... are proposed in which it is possible to come very close to the π, K, N, and Λ poles. From these experiments it is in principle possible to extract the most accurate values of the KNY, $\Sigma\pi\Lambda$, ... coupling constants and to state the problem of the nature of the corresponding exchange. A critical analysis of the corresponding data on the $pp \to \pi^+ + \ldots$ reaction is carried out.

57796 Physics of relativistic nuclei. Baldin, A.M. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 3, 175-195(May 1977).

The investigation of collisions of relativistic nuclei and recent successes in this field are reviewed. The justification, physical motivation, and technical developments in investigations with relativistic nuclei are discussed. The cumulative effect, in which the energy transferred to the produced particles is much higher than the energy per nucleon of the incident nucleus, exhibits simple regularities which have been observed and investigated at Dubna. Scaling behavior and also very unusual A-dependences of the invariant cross section of this effect are established. Study of the cumulative effect may cast light on the interaction between quarks at large distances. In the Appendix, the program of investigations with relativistic nuclei at the High Energy Laboratory at Dubna is briefly reviewed.

57797 Inclusive processes with large transverse momenta in the composite particle approach. Kvinikhidze, A.N.; Sisakyan, A.N.; Slepchenko, L.A.; Tavkhelidze, A.N. (Institute of Mathematics, Academy of Sciences of the Georgian SSR, Tbilisi). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 3, 196-221(May 1977).

In the framework of quantum field theory, inclusive distributions are represented in a form that admits a quark-parton interpretation. On the basis of these representations, conclusions are drawn concerning the dependence of the inclusive spectra on the momentum transfer and the change in these dependences at short distances. A review is made of the main experimental results and the modern theoretical models of inclusive processes with large transverse momenta.

57798 Statistical theory of multiple production of hadrons. Tyapkin, A.A. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 3, 222-237(May 1977).

The main investigations on the statistical theory of multiparticle production are reviewed critically. It is considered whether the general solution to the problem can be found unambiguously on the basis of the principles of statistical physics. It is shown that one must take into account one-dimensional and thermal expansion of the system. On this basis, a general relation for the multiplicity is obtained.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

57799 Symmetry groups of completely integrable equations. Konopel'chenko, B.G. (Institute for Nuclear Physics, Siberian Division, USSR Academy of Sciences, Novosibirsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 349-355(Sep 1977).

It is shown that the symmetry groups of completely integrable equations are infinite groups of the type G/sub n/$_\infty$, which in terms of appropriate variables are finite-parameter groups G/sub n/, with parameters depending locally on the infinitesimal operators of the group G/sub n/. These variables are indicated in the paper. Infinite sets of commuting integrals of the motion of completely integrable equations correspond to the Abelian subgroups of the group G/sub n/$_\infty$.

GENERAL

57800 (LA-UR—78-1344) **Embeddings of SU/sup c/$_3$ in unifying gauge groups.** Slansky, R. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 32p. (CONF-780480—1). Dep. NTIS, PC A03/MF A01.

From Workshop on current problems in particle physics; Baltimore, MD, USA (21 Apr 1978).

Hypothetical models that attempt to unify electromagnetic, weak, and strong interactions into a simple, compact gauge group G are discussed. The problem of embedding the strong group SU$_3$/sup c/ in any larger simple group is solved, and a complete classification of theories where the color in some representation is restricted to 1/sup c/, 3/sup c/, and anti 3/sup c/ is given.

57801 Color degrees of freedom in hadron physics. Govorkov, A.B. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Particles Nucl. (Engl. Transl.);* **8**: No. 5, 431-451(Sep 1977).

Quark models including the extra color degree of freedom are reviewed. The various ways in which color can be manifested are

considered. The experiments by means of which it could be established whether quark charges are integral or fractional are discussed.

57802 Asymptotic freedom, zero charge, and intrinsic symmetry in $(phi^3)_6$ theory. Panfil', S.L. (Novosibirsk State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 584-585(May 1977).

The asymptotically free $(phi^3)_6$ theory is considered. It is shown that variation of the intrinsic symmetry can destroy the asymptotic freedom. For example, for SU (3) and SU (4) we deal with the zero-charge case, but for SU (N) with N> or =5 the theory is asymptotically free.

FIELD THEORY

57803 (NTIS/PS—78/0162) **Quantum electrodynamics (a bibliography with abstracts). Report for 1964—February 1978.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 214p. NTIS PC N01/MF N01.

Studies of causality, gauge invariance, radiative corrections, symmetry, and vacuum polarization in quantum electrodynamics are cited. (This updated bibliography contains 209 abstracts, 13 of which are new entries to the previous edition.)

57804 (SLAC-PUB—2089) **Remarks on the topology of gauge fields.** Nambu, Y. (Stanford Linear Accelerator Center, CA (USA)). Mar 1978. Contract EY-76-S-03-0326. 6p. (CONF-780145—1). Dep. NTIS, PC A02/MF A01.

From Orbis scientiae conference; Coral Gables, FL, USA (15 Jan 1978).

The topology of gauge fields including vortices, monopoles, and instantons is considered. Action versus free action, a class of almost pure gauges, and the Wilson criteria are discussed. 5 references. (JFP)

57805 Strong P and T noninvariances in a superweak theory. Beg, M.A.B.; Tsao, H. (The Rockefeller University, New York, New York 10021). *Phys. Rev. Lett.;* **41**: No. 5, 278-281(31 Jul 1978).

We show, by explicit construction of a highly convergent superweak theory of CP nonconservation, that the problem of natural suppression of strong P and T noninvariances: in the presence of instantons: may be resolved without invoking symmetries which imply massless quarks or nearly massless bosons.

57806 Azimuthal correlations in e^+e^- jets: A test of quantum chromodynamics. Pi, S.; Jaffe, R.L.; Low, F.E. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **41**: No. 3, 142-145(17 Jul 1978).

In $e^+e^- \rightarrow$ hadrons an azimuthal angular correlation between a plane defined by the hadrons and the plane formed by the beams and the jet axis is possible. In the naive parton model the correlation vanishes. In quantum chromodynamics it does not and with reasonable assumptions may be reliably calculated in perturbation theory for large center-of-mass energy. We calculate it in lowest nontrivial order and discuss its physical origins and experimental observations.

57807 Asymptotic hadronic form factors in quantum chromodynamics. Chernyak, V.L.; Zhitnitskii, A.R.; Serbo, V.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Radiowave Propagation). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 11, 594-597(5 Dec 1977).

We present a method that makes it possible to obtain exact (in all orders in the coupling constant) asymptotic expressions for the hadronic form factors in quantum chromodynamics. The method can be used also to calculate the form factors of bound states in other field-theory models, to calculate the hadronic large-angle scattering amplitudes, and so on. By way of example, the method is used to determine the exact asymptotic form of the pion electromagnetic form factor.

57808 Realistic factorized S matrix in two-dimensional space-time with isotopic symmetry O (N). Zamolodchikov, A.; Zamolodchikov, A. (Institute of Theoretical and Experimental Physics). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 8, 457-460(20 Oct 1977).

A factorized O (N) symmetrical S matrix is constructed and it is argued that it is the exact S matrix of a two-dimensional O (N) - chiral model of field theory.

57809 Density matrix for the multiple production of soft mesons. Savrin, V.I. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 565-568(May 1977).

An equation for the density matrix is used to calculate the inclusive cross section for producing soft mesons. The results are in agreement with the conclusions of the optical model of multiple production, thereby confirming the assumptions of this model.

57810 Interference of interacting identical particles. Kopylov, G.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 578-583(May 1977).

A very simple model Lagrangian, leading to the interference of identical mesons produced in high energy collisions, is presented. An interaction between the mesons is included in the Lagrangian and this makes it possible to calculate corrections to the meson interference due to strong interactions between them. It is shown that only the imaginary part of the scattering amplitude influences the interference and that this effect can be neglected for $\pi^+\pi^+$ or $\pi^-\pi^-$ pairs.

57811 Renormalization of the Yang-Mills theory in the two-loop approximation in an arbitrary gauge. Vladimirov, A.A.; Tarasov, O.V. (Joint Institute for Nuclear Research, Dubna). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 585-587(May 1977).

The Gell-Mann—Low function and the anomalous dimensions of propagators in the Yang-Mills theory are calculated in the two-loop approximation for an arbitrary value of the gauge parameter.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 58058

57812 (BNL-NCS—50681) **Symposium on neutron cross sections from 10 to 40 MeV.** Bhat, M.R.; Pearlstein, S. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1977. Contract EY-76-C-02-0016. 561p. (CONF-770523—; ERDA/NDC—11/L; NEANDC(US)—202/L; INDC(USA)—78/L). Dep. NTIS, PC A24/MF A01.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

The conference contained 39 papers. Separate abstracts were prepared for 29 papers. The other ten abstracts appeared previously in ERA. (JFP)

57813 (BNL-NCS—50681, pp 36-40) **Integral experiments and data testing.** Leonard, B.R. Jr. (Battelle Pacific Northwest Labs., Richland, WA). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The present status of theoretical analysis and its agreement with integral and microscopic experiments is assessed. Problems still awaiting solution are discussed. Four specific recommendations are made with respect to 14-MeV source experiments. Data needs in support of d, Be and d, Li neutron source radiation damage experiments are set forth. (RWR)

57814 (BNL-NCS—50681, pp 41-47) **Data evaluation and nuclear model codes.** Young, P.G. (Los Alamos Scientific Lab., NM). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The workshop on this topic addressed problems associated with nuclear data evaluation and model code calculations required for analysis of materials damage studies in the neutron energy range 10 to 40 MeV. Discussions by the group regarding the present status of evaluation and nuclear models, problem areas in model calculations (level densities, noncompound effects, optical model parameters, gamma-ray strength functions, isospin effects), and recommendations and conclusions regarding future work are summarized. 1 table. (RWR)

57815 (BNL-NCS—50681, pp 435-451) **Neutron evaluation at high energies: problems and prospects.** Stewart, L.; Arthur, E.D. (Los Alamos Scientific Lab., NM). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Although the near-term fusion reactor is designed to operate on the T(d,n) reaction, which has a maximum neutron energy slightly above 14 MeV, for the d-Li source (designed primarily for radiation damage studies) more than half the neutrons may have energies above 14 MeV. With the extension of nuclear data requirements to high neutron energies, the need to understand the specific evaluation requests becomes crucial due to the fact that the complexity of the reaction mechanism increases with increasing neutron energy. Some of the problems which beset the evaluator in this high-

energy region and some "probable" solutions for a near-term data base are briefly described. 8 figures, 7 tables. (RWR)

57816 Nuclear structure reference, 1975—1977. Ewbank, W.B.; Haese, R.L.; Hurley, F.W.; McGinnis, M.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). *Nucl. Data Sheets;* **24**: No. 4, 445(Aug 1978).

An indexed guide to experimental nuclear physics papers published between January 1975 and December 1977 is presented. An extensive bibliography is included.(AIP)

57817 Recent References. Ewbank, W.B.; Haese, R.L.; Hurley, F.W.; McGinnis, M.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Nucl. Data Sheets;* **24**: No. 3, 339-371(Jul 1978).

References, key words, key numbers, and reaction indexing are given for all literature received by the Nuclear Data Project or assigned key numbers between January 1978 and April 1978. (AIP)

EXPERIMENTAL TECHNIQUES

REFER ALSO TO CITATION(S) 57478

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57851

57818 (LA—7378-MS) **^{4}He(d pol,d)^{4}He scattering from 12 to 17 MeV.** Brown, R.E.; Grueebler, W.; Hardekopf, R.A.; Correll, F.D.; Jarmie, N.; Ohlsen, G.G. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

Differential cross sections and vector and tensor analyzing powers were measured for vector d + ^{4}He elastic scattering at deuteron lab energies of 12, 14, 15, and 17 MeV. The data were tabulated and compared with predictions from a recent phase-shift analysis, which did not include the present results in the fitting procedure. Significant discrepancies between the predictions and measurements occur, principally for the tensor analyzing powers at backward angles. It is concluded that the present data should be incorporated into the phase-shift analysis to obtain a more realistic solution. 3 figures, 5 tables.

57819 Isovector radiative decays and second-class currents in mass 8 nuclei. Bowles, T.J.; Garvey, G.T. (Princeton University, Princeton, New Jersey 08540). *Phys. Rev., C;* **18**: No. 3, 1447-1451(Sep 1978).

The total isovector M1 radiative width of the 16.6-16.9 MeV doublet in ^{8}Be to the broad first excited state has been measured via the ^{4}He(α,γ) reaction to be 6.10 +- 0.53 eV. Angular distributions at the 16.6 and 16.9 MeV resonances have been measured and determine the isovector E2 to isovector M1 mixing ratio to be δ[(E2,T = 1)/(M1,T = 1)] = 0.19 +- 0.03. A comparison of these results with recent β-α angular correlation measurements of ^{8}Li and ^{8}B is consistent with predictions of the conserved vector current theory and the absence of a second-class induced tensor form factor.

57820 Polarization analyzing power A/sub y/(θ) in pp elastic scattering at 643, 787, and 796 MeV. Bevington, P.R.; McNaughton, M.W.; Willard, H.B.; Baer, H.W.; Winkelmann, E.; Cverna, F.; Chamberlin, E.P.; King, N.S.P.; Stevens, R.R.; Wilmes, H.; Schardt, M.A. (Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev. Lett.;* **41**: No. 6, 384-387(7 Aug 1978).

Data have been obtained for the polarization analyzing power A/sub y/(θ) in pp elastic scattering from near 30° to 90° (c.m.) at 643, 787, and 796 MeV. Relative uncertainties are typically +- 0.003 with an overall normalization uncertainty of (+^{1}/sub -0.5/) %. Data are not consistent with existing phase-shift analyses.

57821 Differential spectra of neutrons from muon capture by deuterium. Dogotar', G.E.; Eramzhyan, R.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 256-259(Sep 1977).

The differential spectrum of neutrons emitted in the capture of muons by deuterons is investigated and the dependence of the spectrum on the neutron-neutron scattering length and the induced pseudoscalar interaction constant is analyzed.

57822 Momentum distribution of nucleons in deuterium from the D (e,e'p) n reaction. Agranovich, V.L.; Kuz'menko, V.S.; Sorokin, P.V. (Khar'kov Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 595-596(May 1977).

Using data on electron-deuteron quasi-elastic scattering, nuclear S and D-state wave functions are determined. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

57823 Investigation of the structure of ^{4}He in a translationally invariant oscillator basis. Bartaya, O.L.; Macharadze, T.S. (Institute of Physics, Georgian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 621-624(Dec 1977).

The binding energy, mean square radius, and charge form factor of the ^{4}He nucleus are calculated using a translationally invariant basis. The realistic local nucleon-nucleon potential of Gogni, Pires, and De Tourreil [Phys. Lett. B 32B, 591 (1970)] is used in the calculations. Taken into account in the basis are all translationally invariant oscillator states with spatial symmetry [f]=4] and number of excitation quanta N< or =8 and with symmetry [f]=22] and N< or =6.

57824 Potential harmonics and matrix elements of 0$^+$ levels of the ^{16}O nucleus. Bursak, A.V.; Verzhbitskii, V.V.; Gorbatov, A.M.; Krylov, Y.N.; Solovei, A.B. (Kalininsk State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 260-261(Sep 1977).

Orthonormalized potential harmonics with arbitrary K are constructed for the 0$^+$ levels of the ^{16}O nucleus and for the central part of the NN interaction in the loop approximation. Simple formulas are obtained for the matrix elements W/sub K/Km-italicin (rho). The contributions of the potential harmonics to the binding energy of the ^{16}O nucleus are estimated by using as examples the potentials that account correctly, in first-order approximation, for the binding energies and for the radii of the nuclei in the periodic table.

NUCLEAR REACTIONS AND SCATTERING

57825 (BNL-NCS—50681, pp 515-532) **Intranuclear-cascade-evaporation model for inelastic nuclear collisions and its application in biomedical and MFE research.** Gabriel, T.A.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

A brief description of the intranuclear cascade evaporation model is given and comparisons between results obtained with this model and experimental cross section data are presented. Also transport calculations carried out using differential cross section data obtained with the studied model are presented and compared with experimental data. These comparisons are, it is expected, sufficient to indicate that the model is not completely unreliable in the energy region of interest below 50 MeV and to indicate that transport calculations of interest in biomedical and magnetic fusion energy applications can at present be carried out. 26 references. (JFP)

57826 Simple potential model for the ^{12}C+^{16}O resonances. Golin, M. (Brookhaven National Lab., Upton, N.Y. (USA)). *Phys. Lett., B;* **74**: No. 1, 23-26(27 Mar 1978).

The real part of the optical potential for ^{12}C+^{16}O scattering is calculated in a microscopic double-folded model. The positions and spins of the known resonances are well reproduced by the calculation. A moderate, energy-dependent absorption gives good agreement with the angular distribution data.

57827 Inelastic form factors of light nuclei in the K-harmonics method. Goncharova, N.G.; Mulei, M.; Shitikova, K.V. (Institute of Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 624-626(Dec 1977).

Inelastic form factors of anomalous-parity states in p-shell nuclei are calculated by the K-harmonics method in the minimal-K approximation. The form factors of J/sup π/=1$^-$, T=1 levels in ^{16}O are compared with shell-model calculations. The effect of nuclear monopole excitations on the behavior of the inelastic form factors is considered.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

57828 Proton elastic and inelastic scattering at 0.8 GeV from / sup 12,13/C and ^{208}Pb<. Blanpied, G.S.; Coker, W.R.; Liljestrand, R.P.; Hoffmann, G.W.; Ray, L.; Madland, D.; Morris, C.L.; Pratt, J.C.; Spencer, J.E.; Thiessen, H.A.; Kozlowski, T.; Hintz, N.M.; Kyle, G.S.; Oothoudt, M.A.; Bauer, T.S.; Igo, G.; Ridge, R.J.;

Whitten, C.A. Jr.; Lang, P.M.; Nann, H.; Seth, K.K. (University of Texas, Austin, Texas 78712). *Phys. Rev., C;* **18**: No. 3, 1436-1446(Sep 1978).

Angular distributions for the elastic and inelastic scattering of 0.8 GeV protons from ^{12}C, ^{13}C, and ^{208}Pb have been measured. Reported are data for the ground, 4.4 MeV 2^+, 7.6 MeV 0^+, 9.6 MeV 3^-, and 14.1 MeV 4^+ states of ^{12}C; the ground, 3.1 MeV $1/2^+$, 3.7 MeV $3/2^-$, 6.9 MeV $5/2^+$, 7.6 MeV $5/2^-$, and 11.9 MeV () states of ^{13}C; and the ground, 2.6 MeV 3^-, and 3.2 MeV 5^- states of ^{208}Pb. Analyses of the elastic angular distributions are made using the partial wave formalism and the Kerman-McManus-Thaler approach to the nucleon-nucleus optical potential; a realistic spin-orbit term is included. The inelastic transitions are analyzed within the framework of the distorted-wave Born-approximation, using transition strengths consistent with previous low-energy studies of inelastic scattering. A simple single-particle-plus-excited-core model is used for ^{13}C. In terms of this analysis, an assignment of J/sup π/ = (5/2,7/2)$^+$ is made for the 11.9 MeV state in ^{13}C.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57710, 57828

57829 (BNL-NCS—50681, pp 125-133) **Neutron spectra from deuteron and proton bombardment of thick lithium targets.** Nelson, C.E. (Duke Univ., Durham, NC); Purser, F.O.; Von Behren, P.; Newson, H.W. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The thick target yields and average neutron energies for E/sub n/ > 1.0 MeV are given from a determination of the average neutron energy and yield of thick lithium targets undergoing the (d,n) and (p,n) reactions at deuteron energies of 8 to 15 MeV and proton energy of 15 MeV. Neither target produced a suitable fast neutron beam for therapy. 11 references. (JFP)

57830 (BNL-NCS—50681, pp 277-285) **Evaluation of the neutron-induced reaction cross sections on carbon from 10 to 20 MeV.** Haouat, G.; Lachkar, J.; Delaroche, J.P.; Patin, Y.; Sigaud, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Available data on the neutron-induced reactions on carbon are reviewed for the energy range from 10 to 20 MeV. Evaluated cross sections obtained at Bruyeres-le-Chatel are discussed. Comparisons with coupled-channel calculations are presented for the total, elastic, and inelastic (to the 2^+ level) cross sections of ^{12}C.

57831 (BNL-NCS—50681, pp 321-350) **MFE damage analysis program nuclear data needs.** Doran, D.G. (Hanford Engineering Development Lab., Richland, WA); Heinrich, R.R.; Greenwood, L.R.; Farrar, H. IV. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Nuclear data needs for the ERDA-DMFE Damage Analysis and Fundamental Studies program fall into three categories: reaction cross sections for dosimetry, cross sections for transmutation reactions, especially those producing helium and hydrogen, and differential scattering cross sections and emitted particle angular and energy distributions for calculating primary recoil spectra. The ENDF/B Dosimetry File must be expanded and extended to 30 to 40 MeV (specific reactions are given); integral testing of cross sections in high energy fields is especially needed. Gas production files must also be extended to 30 to 40 MeV although high accuracy is not generally needed. Direct measurements of accumulated helium can be made. Cross sections must be adequate in the 15 to 40 MeV range to estimate solid transmutant concentrations as well. Sensitivity studies are desirable to assess needed accuracies of cross sections and emission spectra for damage calculations. For this application, it may be that theoretical calculations, supplemented by a limited experimental program, will suffice.

57832 (BNL-NCS—50681, pp 391-401) **Integral testing of neutron activation cross sections using the $^9Be(d,n)$ reaction at 14 to 16 MeV.** Greenwood, L.R.; Heinrich, R.R. (Argonne National Lab., IL). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Integral measurements were made for 22 neutron activation cross sections by use of the $^9Be(d,n)$ source at 14 to 16 MeV at the Argonne Tandem Accelerator. The differential neutron flux and spectra were measured in the angular range from 0 to 25° by the time-of-flight technique. Comparison of the integral and differential results allows an evaluation of accuracy and consistency of differential neutron cross section data. 3 figures, 4 tables.

57833 (BNL-NCS—50681, pp 413-431) **Integral measurement to test evaluated neutron cross sections for carbon.** Morgan, G.L. (Oak Ridge National Lab., TN). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Measurements were made of the spectra of scattered neutrons from a thick carbon sample for incident neutron energies from 1 to 20 MeV in order to provide data suitable for testing the evaluated neutron data files for those elements which are important in the analysis of radiation transport problems for thermonuclear neutron sources. The technique gives an additional advantage of testing the cross section sets in the same context as they are used in applied transport problems. The results found for carbon are generally good with small improvements possible in the higher energy region. 14 references. (JFP)

57834 **Inclusive cross sections, p (0.8 GeV) + A → p + X, up to the ^6Li elastic limit.** Frankel, S.; Frati, W.; Blanpied, G.; Hoffmann, G.W.; Kozlowski, T.; Morris, C.; Thiessen, H.A.; Van Dyck, O.; Ridge, R.; Whitten, C. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev., C;* **18**: No. 3, 1375-1378(Sep 1978).

Results of experimental measurements on protons produced at 100° and 158° from ^6Li, ^9Be, and ^{181}Ta targets are presented and compared with the mass number (A), angular (θ), and momentum dependence of "quasi-two-body scaling."

57835 **Analyzing power in inclusive proton-nucleus cross sections.** Frankel, S.; Frati, W.; Gazzaly, M.; Hoffmann, G.W.; Van Dyck, O.; Woloshyn, R.M. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev. Lett.;* **41**: No. 3, 148-151(17 Jul 1978).

This paper reports measurements of the analyzing power, A/sub y/, in the production of both "backward" protons and forward (quasifree scattering) protons in the reaction p + A → p + X, using 800-MeV polarized protons. For the backward protons the measurements show large negative A-dependent values of A/sub y/ at low momenta, changing to large positive values at high momenta; in the quasielastic region, A/sub y/ is large and positive, is smaller than A/sub y/ measured in hydrogen, and decreases with increasing A.

57836 **(π^-,π^-p) reaction in light nuclei at 170 MeV meson energy.** Berdnikov, Y.A.; Gismatulin, Y.R.; Lantsev, I.A.; Ostroumov, V.I. (Leningrad Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 499-502(May 1977).

Nuclear emulsions have been used to study the (π^-,π^-p) reaction in C and O nuclei at a π^- energy of 170 MeV. Values are obtained for the integrated reaction cross section, the momentum and angular distributions of the residual nuclei, the energy and angular distributions of the protons, and the differential cross section for scattering of π^- mesons. The experimental distributions are compared with calculations using the dispersion theory of direct nuclear reactions. It is concluded that there is a dominant contribution of the pole mechanism in the region of small momentum transfers to the nucleus (less than 150 MeV/c) and an estimate is made of the contribution of other mechanisms.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

57837 **Hartree-Fock calculation of nuclear mass and neutron distributions.** Inopin, E.V.; Kuprikov, V.I.; Gonchar, V.Y. (Khar'kov Physicotechnical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 280-282(Sep 1977).

Results are presented of calculations of the distributions of the nuclear mass and of the neutron density by the Hartree-Fock method with the Skyrme (S3) interaction for the nuclei ^{28}Si, /sup 32,34/S, and /sup 40,48/Ca. It is shown that this method results in good agreement with the experimental cross sections obtained in Gatchina and analyzed by the Glauber method for the scattering of 1-GeV protons by all nuclei. The calculated distribution of the neutron excess of the ^{48}Ca nucleus is also in good agreement with experiment.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57825, 57837, 57905

57838 Regge pole analysis of the scattering of ^{16}O by ^{28}Si. Takemasa, T.; Tamura, T. (Department of Physics University of Texas, Austin, Texas 78712). *Phys. Rev., C;* **18**: No. 3, 1282-1292(Sep 1978).

By using several optical potentials which fit satisfactorily results of a recent experiment on the elastic scattering of ^{16}O by ^{28}Si at E/sub lab/ = 55 MeV, exact calculations were performed so as to locate the positions of the Regge poles, and to evaluate the associated residues and corresponding background integrals. Based on the results thus obtained, a discussion is given of the roles which the pole and background terms play in the description of the scattering between two heavy ions.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 57843

57839 Spin cutoff parameters for ^{28}Si, ^{29}Si, and ^{30}P; Comparison of measurements with spectral distribution calculations. Grimes, S.M.; Poppe, C.H.; Wong, C.; Dalton, B.J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., C;* **18**: No. 3, 1100-1109(Sep 1978).

Spin cutoff parameters for ^{28}Si, ^{29}Si, and ^{30}P have been deduced from angular distribution measurements for (α,n) reactions on ^{25}Mg, ^{26}Mg, and ^{27}Al. Calculations of the spin cutoff parameter which include the effect of two body interactions are made using the theory of spectral distributions. The results obtained by dividing the space into subspaces and expanding the strength distribution of each in a Gaussian are found to be more reliable than calculating a single Gaussian for the entire space. The comparisons in this study indicate a need for the inclusion of higher moments of the Hamiltonian in the level density expansion.

57840 Upper limit on parity mixing in ^{21}Ne. Snover, K.A.; von Lintig, R.; Adelberger, E.G.; Swanson, H.E.; Trainor, T.A.; McDonald, A.B.; Earle, E.D.; Barnes, C.A. (Physics Department, University of Washington, Seattle, Washington 98195). *Phys. Rev. Lett.;* **41**: No. 3, 145-148(17 Jul 1978).

The parity-nonconserving circular polarization of γ rays from the 2.789 → 0.0 MeV transition in ^{21}Ne is found to be (-9 +- 51) x 10^{-4}, which corresponds to a parity-mixing matrix element vertical-bar < H/sub P/NC > vertical-bar = 0.009 +- 0.054 eV between the 2.80-MeV, J/sup π/ = $1/2^{+-}$ levels. This value is considerably smaller than the measured parity mixing in the J = 1/2 doublet in ^{19}F.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57490, 57831

57841 (LA-UR—78-2311) **High-energy, heavy-ion elastic scattering.** DeVries, R.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

Measurements of heavy-ion elastic scattering at the highest available bombarding energies (E/sub i/ approximately greater than or equal to 15 Mev/A) have revealed considerable information about the heavy-ion-nucleons interaction. In particular a pronounced transition of scattering characteristics is observed between light-ions (A less than or equal to 6) and heavy-ions (A greater than or equal to 12).

57842 Systematics of 0° neutron production by 800 MeV protons on targets with 27 < or = A < or =238. Bonner, B.E.; Simmons, J.E.; Newsom, C.R.; Riley, P.J.; Glass, G.; Hiebert, J.C.; Jain, M.; Northcliffe, L.C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **18**: No. 3, 1418-1425(Sep 1978).

The 0° neutron spectra resulting from 800 MeV proton bombardment of targets of Al, Ti, Cu, W, Pb, and U have been measured for neutron momenta above 500 MeV/c. Integrated cross sections for the quasielastic charge exchange peaks and the broad pion associated peaks at lower momenta show a remarkably smooth dependence on atomic mass of the target, varying as A/sup 2/3/ and A/sup 1/2/, respectively.

57843 Levels of ^{33}S excited by α-capture reactions. Okon, O.B.; Bakhru, H.; Sen, P.; Cue, N. (State Univ. of New York, Albany (USA). Dept. of Physics). *Z. Phys., A;* **285**: No. 2, 207-214(1978).

Highly excited levels of ^{33}S populated by α-particle capture in ^{29}Si have been investigated for E/sub α/ = 1.962 MeV to 4.287 MeV. Excitation curves measured with Ge(Li) and BF_3 detectors are reported. More than fifty resonances can be identified with levels in ^{33}S. (α,γ) angular distributions measured on five strong resonances have yielded J/sup π/ values $1/2^+$, $3/2^+$,, $5/2^-$, $5/2^-$, $5/2^-$ and $3/2^+$ respectively, for the E/sub x/ = 10.054, 10.466, 10.523, 10.721, 10.758 and 10.776 MeV levels in ^{33}S. Elastic scattering experiments have been performed, and the J/sup π/ assignments are found to be consistent with the l-values inferred from the elastic scattering data. Decay schemes from the above ^{33}S levels have been proposed. A new level at 9.245 MeV is also suggested and the J/sup π/ values for the 4.425 and 2.87 MeV states are shown to be consistent with $7/2^+$ and $3/2^+$ assignment, respectively.

57844 Effect of nuclear form factors in the reaction A $(\pi^+,2p)$ B. Grashin, A.F.; Shalamova, N.Y.; Shalamov, Y.Y. (Moscow Regional Pedagogic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 614-615(Dec 1977).

New experimental data have been obtained on the reaction A $(\pi^+,2p)$ B* in the nuclei of a Freon mixture. It is shown that the distribution in momentum transfer can be described by a pole diagram with inclusion of the form factor for A→dB*.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 57837

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57825

57845 (BNL-NCS—50681, pp 491-513) **Neutron, proton, and deuteron induced reaction products in the 10 to 40 MeV range.** Divadeenam, M. (Brookhaven National Lab., Upton, NY). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Neutron, proton and deuteron induced excitation functions for several target nuclei (^{51}V, ^{56}Fe, ^{58}Ni, ^{65}Cu, ^{90}Zr, ^{93}Nb, and ^{181}Ta) were calculated employing the GDH pre-equilibrium model of Blann and the Weisskopf-Ewing evaporation model in the 10 to 40 MeV range. In some instances calculations were extended beyond 40 MeV. Agreement between theory and experiment is fair to good in most of the cases investigated in spite of the simple nature of the theoretical model employed. Limitations of the nuclear model and possible improvements are discussed.

57846 Cross sections for the interaction of solar neutrinos with the nuclei ^{55}Mn, ^{71}Ga, and ^{87}Rb. Domogatskii, G.V. (Institute for Nuclear Research, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 596-597(May 1977).

The cross sections are calculated for the solar neutrino reaction (ν,e^-) based on recent experimental data. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

57847 Neutron total cross section and resonance parameters of ^{58}Fe. Garg, J.B.; Jain, S.; Harvey, J.A. (State University at Albany, Albany, New York 12222). *Phys. Rev., C;* **18**: No. 3, 1141-1147(Sep 1978).

Neutron total cross section measurements in the energy range from 30 eV to 500 keV have been made using a pulsed neutron time-of-flight method with a 78.2 m flight path and a nominal resolution of about 0.07 ns/m. From the analysis of the data up to 350 keV we have obtained values of the s- and p-wave neutron strength functions and of the mean level spacings. These are S_0 = (3.2 +- 1.4), S_1 = (0.68 +- 0.13) in units of 10^{-4} eV/sup -1/2/, <D>/sub l/ = 0 = (32 +- 12) keV and <D>/sub l/ = 1 = (8 +- 1) keV.

57848 Positive-parity states in ^{43}Ti. Meyer-Schuetzmeister, L.; Elwyn, A.J.; Gronemeyer, S.A.; Hardie, G.; Holland, R.E.; Rehm, K.E. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 3, 1148-1157(Sep 1978).

Positive-parity states of ^{43}Ti were studied in the $^{40}Ca(\alpha,n)$ ^{43}Ti reaction with alpha particles of 20-MeV energy. Using a pulsed beam the mean lifetime of the $3/2^+$ state at 313.0 keV was measured to be tau = 18.2 +- 0.8 μsec. This leads to a B (M2) value of 0.0334 Weisskopf units, very close to that of the corresponding $3/2^+ \rightarrow 7/2^-$ (g.s.) transition in ^{43}Sc. γ decay of the levels in the mirror nucleus ^{43}Sc suggests that positive-parity states in ^{43}Ti, and only these,

decay to the ground state predominantly via the isomeric $3/2^+$ state. Hence the γ rays emitted from positive-parity states are selected by measuring a γ-ray spectrum in coincidence with the delayed 313.0-keV γ rays. Three γ rays of 709.4, 1040.0, and 1170.5 keV were observed which lead to ^{43}Ti states $5/2^+$ (1022.4 keV), $7/2^+$ (1483.5 keV), and $9/2^+$ (2062.4 keV). As with thee corresponding states in ^{43}Sc, these states form a quasirotational band based on the $3/2^+$ state. The Coulomb displacement energies E/sub C/(Ti) -E/sub C/(Sc) between these ^{43}Ti-^{43}Sc states are large: about 150 keV: and rather spin independent.

57849 Nuclear resonance excitation by sychrotron radiation. Cohen, R.L.; Miller, G.L.; West, K.W. (Bell Laboratories, Murray Hill, New Jersey 07974). *Phys. Rev. Lett.;* **41**: No. 6, 381-384(7 Aug 1978).

We have excited the 14-keV level of the Fe^{57} nucleus using synchroton radiation, and observed the conversion electrons emitted in the decay of that state. We believe this to be the first observation of nuclear excitation via synchrotron-produced x rays.

57850 Nuclear data sheets for A=49. Halbert, M.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). *Nucl. Data Sheets;* **24**: No. 2, 175-262(Jun 1978).

Nuclear structure data available through December 1977 are compiled, and adopted level properties are given. The bulk of the data is presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables and comments are reproduced from the computerized Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the evaluators for maintenance and updating of the computer file.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57490, 57831, 57832, 57842

57851 (TREE—1116, pp 158-160) **Ratio of the hydrogen and manganese cross sections.** Smith, J.R.; Reeder, S.D.; Coursey, B.M.; Spiegel, V. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

A summary of the results of measurements of hydrogen to manganese cross section ratios are tabulated using weighted fits to the experimental data. Comparison of results using volumetric, gravimetric, and densimetric concentration measurements with and without contaminant corrections indicates that the methods are capable of equal accuracy. (SDF)

57852 Study of neutron scattering in the energy region 1.5—3.0 MeV by even—even isotopes of Cr. Korzh, I.A.; Mishchenko, V.A.; Mozhzhukhin, E.N.; Pasechnik, M.V.; Pravdivyi, N.M.; Sanzhur, I.E. (Nuclear Research Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 608-611(Dec 1977).

The time-of-flight method has been used to measure differential cross sections for elastic and inelastic scattering of neutrons with excitation of the first two levels of the isotopes /sup 50,52,54/Cr at neutron energies of 1.5, 2.0, 2.5, and 3.0 MeV. A theoretical analysis of these cross sections in terms of the optical and statistical models of the nucleus is presented. It is shown that the scattering cross sections calculated with inclusion of fluctuations of the level widths satisfactorily describe the experimental data.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57825, 57845

57853 Target residue mass and charge distributions in relativistic heavy ion reactions. Morrissey, D.J.; Marsh, W.R.; Otto, R.J.; Loveland, W.; Seaborg, G.T. (Lawrence Berkeley Laboratory, University of California, Berkeley, California). *Phys. Rev., C;* **18**: No. 3, 1267-1274(Sep 1978).

Calculations of the mass and charge distributions for the heavy target residues from relativistic heavy ion reactions are carried out for the reaction of ^{12}C with ^{238}U, ^{208}Pb, ^{197}Au, Ag, and Cu and compared with experimental data. The primary product distributions are calculated using the abrasion-ablation model. Nuclear charge distributions are calculated using either a stochastic model or a model based upon the zero-point oscillations of the giant dipole resonance. Standard statistical deexcitation calculations are used to calculate secondary product distributions. The results show that some of the principal features of the residue mass and charge distributions can be accounted for with the simple assumptions of the abrasion-ablation model and the assumption that product charge distributions are due to the sudden nature of the interaction and the zero-point oscillations of the giant dipole resonance.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

57854 Structure of ^{78}Ge from the ^{76}Ge(t,p)^{78}Ge reaction. Ardouin, D.; Lebrun, C.; Guilbault, F.; Remaud, B.; Flynn, E.R.; Hanson, D.L.; Orbesen, S.D.; Vergnes, M.N.; Rotbard, G.; Kumar, K. (Institut de Physique de Nantes, B. P. 1044, 44072 Nantes, France). *Phys. Rev., C;* **18**: No. 3, 1201-1206(Sep 1978).

The ^{76}Ge(t,p)^{78}Ge reaction has been performed at a bombarding energy of 17 MeV. Thirteen excited states below 3 MeV excitation are reported with J/sup π/ values obtained by comparison to distorted-wave Born-approximation analysis. A comparison to a dynamical deformation theory is made and the results suggest ^{78}Ge is a transitional nucleus nearing spherical shape due to the proximity of the N = 50 closed shell.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57490, 57831, 57832, 57842

57855 (BNL-NCS—50681, pp 257-276) **Neutron scattering measurements at Ohio University in the energy range 7 to 26 MeV.** Rapaport, J.; Finlay, R.W.; Bainum, D.E.; Carlson, J.D.; Cheema, T.S. (Ohio Univ., Athens). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Since the main bulk of studies about the nucleon model potential optical has been obtained empirically due to limited neutron data input, an attempt is made to remedy this situation by providing accurate neutron elastic and inelastic scattering data in the energy region between 7 and 26 MeV for a large number of nuclei including several enriched isotope samples. The differential cross sections are plotted for various intermediate mass and heavy nuclei. 19 references. (JFP)

57856 Momentum transfer in the reactions of 25-GeV ^{12}C and 28-GeV ^{1}H with Cu. Cumming, J.C.; Haustein, P.E.; Hseuh, H. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **18**: No. 3, 1372-1374(Sep 1978).

The thick-target, thick-catcher technique has been used to determine mean kinetic properties of selected products of the fragmentation of Cu by 25-GeV ^{12}C ions and 28-GeV ^{1}H. Recoil properties of target fragments vary strongly with product mass, but show only a weak dependence on projectile type which is interpreted as indicating small deviations from the limiting fragmentation hypothesis for 2-GeV/nucleon ^{12}C ions.

57857 Pion-induced spallation of copper across the (3,3) resonance. Orth, C.J.; Dropesky, B.J.; Williams, R.A.; Giesler, G.C.; Hudis, J. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **18**: No. 3, 1426-1435(Sep 1978).

Cross sections for about two dozen radioactive spallation products have been measured 50-, 100-, 190-, and 350-MeV π^{+-} and for 200- and 350-MeV proton interactions with copper. Some of measured pion-induced cross sections at 50 and 350 MeV are about the same as for protons of 200 and 590 MeV, respectively. However, at 100 and 190 MeV, nearer to the (3,3) pion-nucleon resonance, these pion-induced cross section sums are 50 to 75% greater than those for protons of similar total energy. Ratios of the π^- to π^+ cross sections are greater than unity for neutron-rich products and less than unity for neutron-deficient products at all four energies, indicating that pion absorption is a substantial reaction mode, even at 190 and 350 MeV. At 100 MeV, and especially at 50 MeV, absorption appears to dominate over inelastic scattering and the σ/sub π^-/σ/sub π^+ ratios are noticeably changed from those at the higher energies. The intranuclear cascade plus evaporation codes reproduce the proton cross sections fairly well. The pion version of the intranuclear cascade code reproduces the pion results quite well at 350 MeV, but is underestimates them significantly at 50 and 100 MeV.

57858 Effect of isospin on electroexcitation of the giant dipole resonance in the nickel isotopes. Khvastunov, V.M.; Berezovoi, V.P.; Likhachev, V.P.; Nemashkalo, A.A.; Savitskii, G.A.; Yaroshevskii, L.D. (Khar'kov Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 491-493(May 1977).

Analysis of the inelastic scattering of electrons by the nuclei / sup 58,60,64/Ni shows the presence of isospin splitting of the giant dipole resonance in these nuclei. The results are compared with the theoretical predictions and with the data of other experiments.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 57825, 57845, 57853

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 57888, 57890

57859 (TREE—1116, pp 214-216) **Study of expanded xenon and samarium decay chain information.** Ottewitte, E.H.; Seiber, S.J. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Direct yields of ^{235}U fission products in the ^{135}I chain are tabulated for thermal, 0.5-MeV, and 14-MeV neutrons. The ^{135}Xe and ^{149}Sm decay chains are shown. 1 figure, 1 table.

57860 **Decay of mass-separated ^{126}Cd.** Gartner, M.L.; Hill, J.C. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., C;* **18**: No. 3, 1463-1468(Sep 1978).

The decay scheme of neutron-rich ^{126}Cd is reported for the first time. Sources of mass-separated ^{126}Cd were produced using an in-beam target ion source combination. The ^{126}Cd half-life was measured to be 0.506 +- 0.015 sec. Of 11 γ rays observed, 10 were placed in a ^{126}In level scheme consisting of 6 excited states at 260, 308, 555, 585, 626, and 688 keV. The level density of low-spin excited states is less than that for ^{124}In, and most of our levels are describable in terms of a single proton hole coupled to a single neutron hole. Surprisingly, most of the β strength feeds one level in ^{126}In at 688 keV.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 57860

57861 **Resonance (n,γ) measurements and weak-coupling model calculations of levels in ^{119}Sn, ^{117}Sn, and ^{115}Sn.** Raman, S.; Carlton, R.F.; Slaughter, G.G.; Meder, M.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., C;* **18**: No. 3, 1158-1177(Sep 1978).

Neutron capture γ-ray measurements have been performed upon enriched samples of ^{118}Sn, ^{116}Sn, and ^{114}Sn following resonance capture. The γ rays, measured with a Ge(Li) detector, have been incorporated in level schemes for ^{119}Sn, ^{117}Sn, and ^{115}Sn. Spin and parity assignments have been made for many of the levels. Neutron separation energies for ^{119}Sn, ^{117}Sn, and ^{115}Sn were determined to be 6484.6 +- 1.5, 6942.9 +- 2.0, and 7545.3 +- 2.0 keV, respectively. The level schemes have been compared with those of heavier Sn isotopes to investigate systematic behavior. Various spectroscopic properties (level energies, electromagnetic moments, and transition rates) of ^{119}Sn, ^{117}Sn, and ^{115}Sn were calculated on the basis of a model which pictures these nuclei as being formed by coupling the motion of the odd neutron quasiparticle to the states of the neighboring even-mass core. The experimentally determined level properties of these Sn isotopes have been qualitatively reproduced by these calculations.

57862 **Excitation and decay of analogs of excited states of ^{119}Sn.** Fitzgerald, D.H.; Lilley, J.S.; Poppe, C.H.; Grimes, S.M. (Department of Physics, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* **18**: No. 3, 1207-1216(Sep 1978).

The (p,n′) reaction to excited isobaric analog states of ^{119}Sn has been observed using a neutron-proton (n-p) coincidence technique. The n-p coincidence was essential to reduce the neutron background due to population of the t/sub less-than/ states. The states preferentially excited are analogs of the 0.920, 0.921, 1.090, and 1.354 MeV states of ^{119}Sn which contain the strength of the 2^+ core excitation. These states are observed to decay overwhelmingly to the first-excited (2^+) state of ^{118}Sn. A value for the overall relative proton decay probability was calculted in order to compare the data with predictions of a two-step model of the (p,n′) reaction. Good agreement with the data was obtained, provided that the imaginary part of the neutron optical potential was reduced by the same factor which previously was found necessary to fit quasi-elastic scattering data.

57863 **Neutron total cross section measurement on ^{140}Ce.** Camarda, H.S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **18**: No. 3, 1254-1261(Sep 1978).

A high resolution neutron time-of-flight experiment for neutron energies 20 < or = E < or = 240 keV was carried out on the target nucleus ^{140}Ce(0^+). The measurement employed a 7.5 nsec beam burst and 250 m flight path. A multilevel shape analysis of the resonance data was performed. The plot of $\Sigma\Gamma$/sub n/^{0} vs E for the l = 0 J/sup π/ = $1/2^+$ levels exhibited a significant change in slope at ~ 160 keV and gives support to the doorway state picture of compound nucleus formation. The observed number of l = 0 levels vs E showed an abrupt increased at 160 keV, the energy at which S_0 also changed. Various statistical tests were applied to see if this was an effect of missing weak levels but a definite conclusion could not be reached. The behavior of the p wave strength function vs energy was found to be suggestive of doorway state structure. After correcting for missing levels the ratio of s to p wave level spacings was found to be 3.0; the theoretical prediction of 2.9 (for σ = 4.9) is in good agreement with experiment. The average s, p strength functions and levels spacings are S_0 = 1.1 x 10^{-4}, S_1 = 0.34 +- 0.05 x 10^{-4}, <D>/sub l/ = 0 = 4.9 keV, <D>/sub l/ = 1 = 1.64 KeV.

57864 **Lowest 2^+ state in $^{146}_{64}Gd_{82}$ and the energy gap at Z = 64.** Ogawa, M.; Broda, R.; Zell, K.; Daly, P.J.; Kleinheinz, P. (Institut fuer Kernphysik, Kernforschungsanlage Juelich, D-5170 Juelich, West Germany). *Phys. Rev. Lett.;* **41**: No. 5, 289-292(31 Jul 1978).

A search for the lowest 2^+ state in ^{146}Gd using (α, 2nγ) excitation function measurements near threshold has located that state at 1971 keV. Its energy, more that 300 keV higher than in any other n = 82 nucleus, provides clear spectroscopic evidence for a large gap in the single-particle spectrum at Z = 64.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57490, 57831, 57855, 57861, 57888

57865 (BNL-NCS—50681, pp 117-124) **Thick target neutron yields from the d-Be reaction at E/sub d/ = 15.6, 29.9, and 49.0 MeV.** Graves, R.G. (Texas A and M Univ., College Station); Smathers, J.B.; Hertel, N.; Otte, V.A.; Almond, P.R.; Grant, W. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The results of the neutron yield measurements are presented including both integral and differential yields. 10 references. (JFP)

57866 (BNL-NCS—50681, pp 287-296) **Nuclear emulsion techniques and data needs for fast neutron angular spectrometry.** Roberts, J.H.; Gold, R. (Westinghouse Hanford Co., Richland, WA). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The significance of angular neutron flux observations in reactor environments is discussed. Special emphasis is placed on effects arising in scalar neutron spectrometry which stem from the existence of angular neutron spectra. The applicability of nuclear emulsion techniques for observing angular neutron spectra is stressed. Cross section requirements are reviewed for nuclear emulsion passive neutron spectrometry above 10 MeV.

57867 (BNL-NCS—50681, pp 305-317) **Cross sections for the Nb(n,xn) and Nb(n,xγ) reactions between 1 and 20 MeV.** Morgan, G.L.; Perey, F.G. (Oak Ridge National Lab., TN). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

In recent years considerable interest has been shown in using niobium as a structural material in practical fusion reactors. Most conceptual design studies use the evaluated nuclear data files (e.g., ENDF/B) as the source of basic microscopic cross section data. The accuracy of the prediction of design criteria such as tritium breeding ratios, radiation damage, and neutron-induced heating is dependent on the accuracy of the evaluated data for energies up to the primary energy of 14 MeV. The existing experimental data on niobium cross sections have been assembled, evaluated, and supplemented with model calculations by Smith, Guenther, and Whalen to form the most recent data file for this nuclide (ENDF/B-IV, MAT 1189). The purpose of the measurements reported here was to provide data to test some aspects of this evaluated cross-section file in the MeV region. The technique used here has the global testing power of an integral experiment, yet retains a sufficiently differential character to allow localization of discrepancies. Differential cross sections are presented for the Nb(n,xn) and Nb(n,xγ) reactions as a function of the incident neutron energy at an average scattering angle of 129 deg. (lab). The data cover the incident neutron energy range from 1 to 20 MeV. Comparisons are presented with cross sections obtained from the evaluation.

57868 (LBL—7727) **Current experimental situation in heavy-ion reactions.** Scott, D.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 178p. Dep. NTIS, PC A09/MF A01.

A detailed survey of the present experimental situation in heavy-ion physics is presented. The discussion begins by considering the simple excitation of discrete states in elastic scattering, transfer, and compound-nucleus reactions; it then turns to more drastic perturbations of the nucleus high in the continuum through fusion, fission, and deeply inelastic scattering, and concludes with the (possibly) limiting asymptotic phenomena of relativistic heavy-ion collisions. 138 figures, 5 tables, 451 references. (RWR)

57869 **Nuclear scaling in absorption of π^+ mesons with energies up to 114 MeV.** Gismatullin, Y.R.; Kosmach, V.F.; Martirosova, A.G.; Ostroumov, V.I. (M. I. Kalinin Leningrad Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 612-614(Dec 1977).

The invariant properties of the scaling function rho are investigated for protons emitted into the backward hemisphere in absorption of π^+ mesons with energies of 40, 80, and 114 MeV by emulsion nuclei. Separate consideration is given to channels of direct interaction of pions with two-particle nuclear correlations, and indirect absorption processes. The distribution of rho in indirect processes in the proton energy region above 30 MeV is approximated by an exponential dependence. The result of the work indicates appearance of nuclear scaling at initial pion energies of 80 and 114 MeV, while the experiment with 40-MeV mesons demonstrates violation of the universality of the scaling function. It is found that the parameter of the photon momentum distribution does not show a dependence on the emission angle.

57870 **Anomalous excitation of ^{152}Sm by DD neutrons.** Sit'ko, S.P.; Andreev, E.A.; Basenko, V.K. (Kiev State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 593-595(May 1977).

The cross sections and gamma spectra obtained in the inelastic scattering of neutrons by ^{152}Sm are compared with the predictions of Hauser-Feshbach theory.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

REFER ALSO TO CITATION(S) 57825, 57845

RADIOACTIVE DECAY

57871 **Measurement and model-independent analysis of the x rays of muonic ^{150}Sm and ^{152}Sm.** Yamazaki, Y.; Shera, E.B.; Hoehn, M.V.; Steffen, R.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **18**: No. 3, 1474-1496(Sep 1978).

Precision measurements, using a highly linear Ge(Li) spectrometer system, have been made of the muonic x-ray spectra of the ^{150}Sm and ^{152}Sm transitional nuclei. Equivalent Barrett nuclear charge radii for both of the isotopes have been determined. Generalized quadrupole moments of the charge distribution as probed by muonic atoms have been determined in a nearly model-independent way, and equivalent quadrupole radii for static and transitional quadrupole charge distributions of the 2^+ states have been determined by comparison with Coulomb excitation data. The isomer shift of the 2^+ state of ^{152}Sm was measured directly from the K x rays, while that of ^{150}Sm was determined from the observed nuclear γ ray. A phenomenological rotation-vibration-interaction model provides a satisfactory explanation for the observed quadrupole moment and isomer shift of the 2^+ state in ^{152}Sm.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 57871

57872 **Alignment of the K = 2^- octupole and ground-band angular momenta in ^{180}W.** Sheline, R.K.; Mann, L.G.; Struble, G.L.; Lanier, R.G.; Carlson, J.B. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev. Lett.;* **41**: No. 6, 374-377(7 Aug 1978).

Excitation of the K = 2^- octupole band up to the 14^- member in the reaction ^{181}Ta(p, 2nγ)^{180}W shows an odd-even energy staggering. This staggering can be interpreted in terms of different Coriolis-induced alignments of the rotational and octupole vibrational angular momenta for the odd- and even-spin members of the K = 2^- octupole band. There is no evidence that the K = 2^- octupole vibration decomposes into two-quasiparticle decoupled states even at the highest spins observed.

57873 **Giant dipole resonance in Hf isotopes.** Goryachev, A.M.; Zalesnyi, G.I. (Saratov State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 246-250(Sep 1977).

Yield curves and photoneutron multiplicities have been measured for the isotopes /sup 176,178,180/Hf in a betatron bremsstrahlung beam in the energy range 8—21 MeV with a 0.125-MeV step. The measurements were made on-line with a computer. The cross sections were calculated from the yield curves by the Penfold-Leiss method with a 1.0-MeV step. The multiplicity curves were used to separate the contributions of (γ,n) and (γ,2n) reactions. Integrated cross sections calculated from the photoabsorption cross sections are given, and also average energies and deformation parameters. The results are compared with calculations using various versions of the model of coupling of dipole and quadrupole vibrations.

57874 **Transmission of polarized resonance neutrons through a polarized ^{159}Tb target.** Alfimenkov, V.P.; Akopyan, G.G.; Vagov, V.A.; Ivanenko, A.I.; Lason', L.; Mareev, Y.D.; Moreva, N.I.; Ovchinnikov, O.N.; Pikel'ner, L.B.; Salai, S.; Sharapov, E.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 495-499(May 1977).

The time-of-flight method in the IBR-30 pulsed reactor has been used to measure the transmission of polarized neutrons with energy 20 eV to 100 keV through a polarized ^{159}Tb target. The spins of 66 neutron resonances with energy up to 310 eV and the spin dependence of the averaged total cross section are obtained. The most accurate upper-limit estimate is obtained for the possible spin effect in the neutron strength function, (S/sub +/-S/sub -/)/ <S>< or =0.05.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57831, 57855

57875 **Study of neutron resonances of the radioactive isotope / sup 152g/Eu.** Vertebnyi, V.P.; Vorona, P.N.; Kal'chenko, A.I.; Krivenko, V.G.; L'vov, S.V.; Pshenichnyi, V.A. (Nuclear Research Institute, Ukrainian Academy Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 601-605(Dec 1977).

The time-of-flight neutron spectrometer at the VVR-M reactor at our Institute has been used to study the neutron resonances of the radioactive isotope /sup 152g/Eu (T/sub 1/2/=12.4 years). More than 20 resonances were observed, of which 12 are satisfactorily described by means of a Breit—Wigner single-level formula. The radiation width varies from resonance to resonance in the range 80 to 270 meV. The average radiation width of the isotope /sup 152g/ Eu is significantly higher than for the isotopes ^{151}Eu and ^{153}Eu and is equal to 160 +- 25 meV. The average observed distance between levels is D-bar/sub obs/=0.25 +- 0.04 eV; S_0, the strength function, is (3.6 +- 1.2) x 10^{-4}.

57876 **Neutron spectra and angular distributions from the reactions ^{181}Ta(p,n)^{181}W and ^{181}Ta(n,n')^{181}Ta.** Biryukov, N.S.; Zhuravlev, B.V.; Kornilov, N.V.; Rudenko, A.P.; Sal'nikov, O.A.; Trykova, V.I. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 606-608(Dec 1977).

Spectra and angular distributions have been measured for neutrons from the reactions ^{181}Ta(n,n')^{181}Ta at initial neutron energy 9.1 +- 0.2 MeV and ^{181}Ta(p,n)^{181}W for E/sub p/=10.2 +- 0.2 MeV. The neutron spectra were measured by the time-of-flight method in the 150-cm cyclotron at our Institute at angles 30, 60, 90, 120, and 150°. It is shown that for identical excitation energy of the nuclei the integrated spectrum of inelastically scattered neutrons has a more energetic form than the neutron spectrum from the (p,n) reaction, and an analysis of the spectra carried out in terms of the model of pre-equilibrium nuclear decay showed that the difference in the fraction of nonequilibrium processes is significantly greater than predicted by the model. The angular distribution of inelastically scattered neutrons has a strong asymmetry in the high energy part, while in the (p,n) reaction it is symmetric within experimental error about 90°. This apparently indicates that direct processes whose contribution to the spectrum in the (p,n) reaction is substantially smaller are responsible for the high-energy portion of the spectrum.

57877 **Disintegration of Ta and W nuclei by electrons and photons of high energy.** Mitrofanova, A.V.; Noga, V.I.; Popov, A.I.; Ranyuk, Y.N.; Telegin, Y.N. (Khar'kov Physico-technical Institute, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 493-495(May 1977).

The induced activity method has been used to measure the yields of 15 photonuclear reactions in tantalum and tungsten nuclei in the photon energy range 600—1300 MeV. The cross sections have been calculated in the approximation of a rectangular bremsstrahlung spectrum. Rudstam's semiempirical formula has been used to analyze the experimental data. For the reactions in tungsten the ratios of the yields produced by photons and electrons have been measured.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 57825, 57853, 57905

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 57879

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 57828

57878 Proton states in ^{193}Ir and ^{195}Ir populated via the (t,α) reaction. Yamazaki, Y.; Sheline, R.K. (Florida State Univ., Tallahassee (USA)); Burke, D.G. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). *Z. Phys., A;* **285**: No. 2, 191-201(1978).

The nuclear structures of ^{193}Ir and ^{195}Ir have been studied using the ^{194}Pt(t,α) and ^{196}Pt(t,α) reactions. Levels up to approximately 2 MeV in excitation energy were studied with a resolution of approximately 13 keV (FWHM) and spectroscopic strengths were extracted. The low-lying states in ^{193}Ir have been interpreted in terms of both the Nilsson and the rotation-vibration models including Coriolis, particle-vibration and rotation-vibrational couplings. The previously assigned $3/2^+[402]$, $11/2^-[505]$, $1/2^+[400]$ and $1/2^+[411]$ bands were populated and candidates for the $5/2^+[402]$ and $7/2^+[404]$ bandheads were observed. The K_0+2 gamma vibration based on the ground state was populated because it is mixed with the $7/2^+[404]$ state. Surprisingly, there was no significant difference between the stripping and pick-up strengths for the low-lying states in ^{193}Ir, suggesting that the equilibrium nuclear shape of ^{193}Ir has large overlaps with the shapes of both ^{192}Os and ^{194}Pt. The nuclear level structure of ^{195}Ir appears to be similar to those of the lighter iridium isotopes.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57831, 57855

57879 (LA-UR—78-2309) **Comparison of alpha decay and alpha transfer reactions in the lead region.** DeVries, R.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

Data were taken for five transitions in the lead region allowing a quantitative comparison with corresponding alpha-decay data via R-matrix theory using the same target + alpha nuclear potential. Good agreement between the absolute reduced widths determined from the two sets of data suggests that in transfer reactions, as in alpha decay, an alpha particle in its ground state is transferred in a one-step process. In a separate analysis, elastic and total reaction cross sections for the systems α + ^{206}Pb, ^{209}Bi were analyzed to obtain a limited set of potentials which, in turn, were used to calculate absolute alpha widths. Existing shell model calculations give γ/sub α/^{2} values three orders of magnitude smaller.

57880 Recoil properties of radionuclides formed in the interaction of 1—300-GeV protons with gold. Kaufman, S.B.; Steinberg, E.P.; Weisfield, M.W. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **18**: No. 3, 1349-1367(Sep 1978).

The thick-target recoil properties of a number of nuclides, varying from ^{22}Na to ^{196}AU, formed in the interaction of 1—300-GeV protons with ^{197}Au have been measured in order to study the systematics of their variation with product mass and incident energy. The forward-to-backward ratios (F/B) of many of the products have a peak at 3 GeV and decrease at higher energies, with products in the mass region $46 < \text{or} = A < \text{or} = 65$ having F/B = 1.0 at 300 GeV. The F/B values of products with A > or ≈ 140 decrease montonically between 1 and 300 GeV. The results are analyzed by the two-step model of high-energy reactions and discussed in terms of the different reaction mechanisms, spallation, fission and fragmentation. Fission contributes appreciably to the formation of products in the mass region $46 < \text{or} = A < \text{or} = 103$ at 1 GeV bombarding energy, but other mechanisms predominate at and above 11.5 GeV. The results are compared to the predictions of intranuclear cascade-evaporation calculations, and are in reasonable agreement at 1 and 3 GeV, although the calculations predict more forward momentum transfer than is observed. At higher energies the relation between forward momentum and mean deposition energy derived from the calculations must break down, because nuclides requiring high deposition energies for their formation have little or no forward momentum. Some possible explanations for this phenomenon are discussed.

57881 Lowered fusion cross section in the quadruply magic heavy-ion system ^{48}Ca+^{208}Pb. Morrissey, D.J.; Loveland, W.; Otto, R.J.; Seaborg, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **74**: No. 1, 35-38(27 Mar 1978).

The results of radioanalytical mass yield distribution studies of the reaction of ^{48}Ca with thick ^{208}Pb targets at the effective laboratory energies of 255 and 300 MeV are reported. Complete fusion cross sections are found to be significantly lower than those found for ^{40}Ar induced reactions with non-magic targets;apparently the effect of the projectile and target nuclear structure on such cross sections can be observed.

SPONTANEOUS AND INDUCED FISSION

57882 Fission of pre-actinide nuclei. The (p,f) reaction in the proton energy region 24—30 MeV. Zhukova, O.A.; Ignatyuk, A.B.; Itkis, M.G.; Mul'gin, A.I.; Okolovich, V.N.; Smirenkin, G.N.; Tishin, A.S. (Nuclear Physics Institute, Kazakh Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 251-256(Sep 1977).

We have used the Alma Ata isochronous cyclotron to measure the integrated and differential cross sections for fission by protons of energy 24—30 MeV for 15 target nuclei in the region W—Bi. The experimental results, analyzed together with similar data for (α,f) reactions, are used to determine the fission barriers and to study the dependence of the fission probability on the introduced angular momentum. An anomalous effect of angular momentum on the fissility of a nucleus, observed in energy regions near threshold, is observed and interpreted.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

57883 Lifetimes of compound nuclei and fission probabilities calculated with allowance for fission after neutron evaporation. Kamanin, V.V.; Karamyan, S.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 616-620(Dec 1977).

A theoretical model is constructed for calculation of the active lifetimes of compound nuclei with allowance for the process of fission after evaporation of neutrons. Use has been made of the formulas of the statistical theory with the level-density function in accordance with a constant-temperature model. It is shown that, simultaneously with obtaining compound-nucleus lifetimes which agree with experiment, it is possible to describe satisfactorily the experimental cross sections for (HI, xn) reactions in the region Z=80—89 without additional variation of the theoretical parameters. The causes of the rapid increase in fission probability in the region Z=86—87 are discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

57884 (SLAC-PUB—2129) **Long-range fission fragments from radiogenic lead.** Maly, J.; Walz, D.R. (Stanford Linear Accelerator Center, CA (USA)). Jun 1978. Contract EY-76-S-03-0326. 11p. (CONF-780333—8). Dep. NTIS, PC A02/MF A01.

From Symposium on superheavy elements; Lubbock, TX, USA (9 Mar 1978).

Fission tracks with a range 19 percent longer than tracks produced by uranium fission fragments were observed on mylar foils after a three-year underground (100 m.w.e.) exposure to 3600 cm^2 of radiogenic lead. Ordinary lead which was simultaneously exposed to mylar foils under the same conditions yielded a background effect of only 3 percent of the effect from radiogenic lead. The observed long-range tracks are best explained as resulting from the spontaneous fission of natural, superheavy elements in the suggested element-114 stability region which were coprecipitated with the radiogenic lead. Most likely they are created by a decay chain starting in the proposed Z = 124 to 126 region from a superheavy element which chemically follows uranium. 2 figures, 3 tables.

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 57888

57885 Alpha decay of ^{246}Cf, ^{248}Cm, and ^{240}Pu. Baranov, S.A.; Shatinskii, V.M. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 244-245(Sep 1977).

We report a study of the α decay of the isotopes ^{246}Cf, ^{248}Cm, and ^{240}Pu. The experiments were carried out with a magnetic α spectrograph with space focusing of the α-particle beam at an

angle $\pi\sqrt{2}$. The isotope ^{246}Cf was obtained from the reaction ^{244}Cm(α,2n). Corresponding experiments used samples highly enriched in the isotopes ^{248}Cm, ^{244}Cm, and ^{240}Pu. We give a summary of the results and the energies of individual α-particle groups, their intensities, and also the energy levels of the daughter nuclei.

ENERGY LEVELS AND TRANSITIONS

57886 Nuclear data sheets for A=229. Toth, K.S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). *Nucl. Data Sheets;* **24**: No. 2, 263-288(Jun 1978).

Nuclear structure information for all nuclei with mass number A=229 is evaluated. The results from various decay experiments and reaction are compared. Adopted data, levels, and spin and parity assignments are given.

57887 Nuclear data sheets for A=233. Ellis, Y.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). *Nucl. Data Sheets;* **24**: No. 2, 289-338(Jun 1978).

The available nuclear structure information for all nuclei with mass number A=233 is presented. Various decay and reaction data are evaluated and compared. Adopted data, levels, spin, parity, and configuration assignments are given.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57831, 57868, 57891

57888 (HEDL-SA—1495-FP) **Fission product and actinide data evaluations for ENDF/B—V.** Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1978. Contract EY-76-C-14-2170. 20p. (CONF-780622—64). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The planned content and performance of fission product and actinide nuclide evaluations for the ENDF/B-V collection of data are reviewed. Representative values of parameters for a few nuclides are shown. 10 figures, 5 tables. (RWR)

57889 (TREE—1116, pp 152-153) **Cross section of ^{237}Np in the CFRMF.** Turk, E.H.; Rogers, J.W.; Helmer, R.G. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

The data for the 984 keV gamma ray of ^{238}Np was used to calculate the cross section for the ^{237}Np(n,γ)^{238}Np reaction. (SDF)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 57292, 57859, 57884

57890 (LA-UR—78-1846) **Integral decay-heat measurements and comparisons to ENDF/B—IV and V.** England, T.R.; Schenter, R.E.; Schmittroth, F. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 43p. (CONF-780546—5). Dep. NTIS, PC A03/MF A01.

From Seminar on nuclear data problems for thermal reactor applications; Upton, NY, USA (22 May 1978).

Results from recent integral decay-power experiments are presented and compared with summation calculations. The experiments include the decay power following thermal fission of ^{233}U, ^{235}U, and ^{239}Pu. The summation calculations use ENDF/B-IV decay data and yields from Versions IV and V. Limited comparisons of experimental β and γ spectra with summation calculations using ENDF/B-IV are included. Generalized least-squares methods are applied to the recent ^{235}U and ^{239}Pu decay-power experiments and summation calculations to arrive at evaluated values and uncertainties. Results for ^{235}U imply uncertainties less than 2% (1 sigma) for the "infinite" exposure case for all cooling times greater than 10 seconds. The uncertainties for ^{239}Pu are larger. Accurate analytical representations of the decay power are presented for ^{235,238}U, and ^{239}Pu for use in light-water reactors and as the nominal values in the new ANS 5.1 Draft Standard (1978). Comparisons of the nominal values with ENDF/B-IV and the 1973 ANS Draft Standard in current use are included. Gas content, important to decay-heat experiments, and absorption effects on decay power are reviewed. 37 figures, 8 tables.

57891 (TREE—1116, pp 146-147) **Integral cross section measurements on ^{242}Pu.** Harker, Y.D.; Turk, E.H. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Neutron capture and fission cross sections were measured for ^{242}Pu by irradiation with reactor neutrons. (SDF)

57892 Spin determination of resonance structure in (^{235}U + n) below 25 keV. Moore, M.S.; Moses, J.D.; Keyworth, G.A.; Dabbs, J.W.T.; Hill, N.W. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **18**: No. 3, 1328-1348(Sep 1978).

Measurements made with a polarized neutron beam and a polarized target of ^{235}U have been analyzed to obtain spin-separated fission cross sections of (^{235}U + n) below 25 keV neutron energy. Analysis of the cross section data in the resolved resonance region has been carried out to obtain a better estimate of average parameters than has been previously available. The average parameters have been used as the starting point for an extraction of energy-dependent average parameters in the unresolved resonance region. The results of this analysis show evidence for intermediate structure in the spin-4 component.

57893 Neutron emission from actinide muonic atoms. Wilcke, W.W.; Johnson, M.W.; Schroeder, W.U.; Huizenga, J.R.; Perry, D.G. (Deparments of Chemistry and Physics and Nuclear Sturcture Research Laboratory University of Rochester, Rochester, New York 14627). *Phys. Rev., C;* **18**: No. 3, 1452-1462(Sep 1978).

The time distribution of neutrons from radiationless muonic transitions and muon capture has been measured for muonic ^{232}Th ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, and ^{242}Pu. Evidence is found for muon capture in fragments from prompt muon-induced fission. Muon-capture rates are deduced and compared to the prediction of the Goulard-Primakoff theory. Isotopic effects of the capture rate are found to be smaller than expected from the systematics. Ratios of Γ/ sub n//Γ/sub f/ are deduced for radiationless transitions. No clear evidence is found for isomeric-state excitation in muonic cascade transitions.

57894 Observation of a new spontaneously fissile nuclide in certain meteorites. Flerov, G.N.; Ter-Akop'yan, G.M.; Popeko, A.G.; Fefilov, B.V.; Subbotin, V.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 237-240(Sep 1977).

Neutron detectors located in a salt mine at a depth of 1100 m.w.e. have been used to investigate the multiple emission of neutrons from samples of the Efremovka, Allende, and Saratov meteorites. The observed multiple neutron emission effect substantially exceeds the background level from spontaneous fission of uranium and from nuclear interactions of cosmic muons. To explain the effect it is necessary to assume the presence in the meteorites of a new long lived spontaneously fissile nuclide whose concentration is 3 x 10^{-15}—3 x 10^{-14} g/g. The average number of prompt neutrons from fission of this nuclide is 4<nu-bar<10.

57895 Symmetric and asymmetric modes of spontaneous fission of ^{252}Cf. Maksyutenko, B.P.; Shimanskii, A.A.; Balakshev, Y.F. (Physics and Power-Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 503-506(May 1977).

The distribution of the cumulative yields of the precursors of four iodine isotopes and ^{135}Sb and ^{143}Cs is found from the falloff in activity of delayed neutrons in spontaneous fission of ^{252}Cf. It is shown that the length of the β-decay chain for heavy fragments is essentially no different from that for ^{235}U. At the same time for light fragments the length of the β-decay chain of ^{252}Cf is higher by 1.3 charge units than for ^{235}U. Thus, the hypothesis of different lengths of the β-decay chains turns out to be unjustified. A correlation is observed between the low yield of fragments in symmetric and highly asymmetric fission, on the one hand, and the lengths of the β-decay chains and the number of neutrons emitted by the light and heavy fragments, on the other hand.

NUCLEAR THEORY

NUCLEAR STRUCTURE

57896 Influence of doorway states on neutron strength functions. Sirotkin, V.K.; Adamchuk, Y.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 262-267(Sep 1977).

The effect of doorway states on the average S matrix is investigated on the basis of the shell-model approach to the theory of nuclear reactions. The obtained expression was used to calculate the strength functions of neutrons for nuclei in the range of atomic numbers 90< or =A< or =142. A model for the density of the doorway states is developed, taking the shell structure of the nucleus into consideration. It is possible within the framework of the presented model to describe satisfactorily the magnitude and isotopic dependence of the s_0 strength functions in the region of the minimum (90< or =A< or =142).

57897 Semi-microscopic description of giant quadrupole resonances in deformed nuclei. Kyrchev, G.; Malov, L.A.; Nesterenko, V.O.; Solov'ev, V.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 506-510(May 1977).

Calculations of giant quadrupole isoscalar and isovector resonances in the random-phase approximation are presented. The

strength functions for E2 transitions are calculated for even-even deformed nuclei in the regions of 150< or =A<190 and 228< or =A< or =248 in the 0—40 MeV energy range. The following integral characteristics of giant quadrupole resonances are obtained: position, width, contribution to the sum rule, and contribution to the total photoabsorption cross section. The calculations show that giant quadrupole resonances are a general property of all the nuclei considered. The calculated characteristics of the isoscalar giant quadrupole resonance agree with the known experimental data. The calculations demonstrate that the semi-microscopic theory can be successfully applied to the description of giant multipole resonances.

57898 Critical nuclear charge for higher levels: numerical calculations and the quasiclassical approximation. Eletskii, V.L.; Popov, V.S. (Institute of Theoretical and Experimental Physics, State Commission on Use of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 587-591(May 1977).

The critical nuclear charge has been numerically calculated for all electronic energy levels which merge with the lower continuum when $Z\alpha<9$. Quasiclassical equations are obtained for the number of states merging with the lower continuum, and this number is compared with the numerical results. Integral representations for the MacDonald function (with an imaginary index) and its derivative are obtained which are useful in numerical work for any arbitrary relationship between the argument and the index.

NUCLEAR MATTER

57899 Heavy ion collisions at intermediate energy. Bertsch, G.; Amsden, A.A. (Physics Department, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev., C;* **18**: No. 3, 1293-1297(Sep 1978).

Two types of measurement are proposed for the analysis of heavy ion collisions in the range of energy of 20—200 MeV/A. First, measurement of the longitudinal component of the kinetic energy of the collision products characterizes the impact parameter of the collision. The distribution in this quantity allows the dissipation in the theoretical models to be determined. A second kind of measurement is that of the coefficients of a spherical harmonic expansion of the angular distribution of the products. Besides giving independent information on the impact parameter and reaction dynamics, measurement of these coefficients offers the possibility of measuring the stiffness of the equation of state of nuclear matter. These ideas are explored in the context of a hydrodynamic model for the collision. In the purely hydrodynamic model there is a large measurable asymmetry in the angular distribution, but the dependence on the equation of state is small.

57900 Influence of shell effects on the π-condensate instability in atomic nuclei. Sapershtein, E.E.; Tolokonnikov, S.V.; Fayans, S.A. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 510-515(May 1977).

The critical parameters determining the π-condensate instability in spherical nuclei from ^{16}O to $^{298}114$ are found. It is shown that in light nuclei as the spin-spin exchange interaction constant is decreased (or in proportion to the increase in the density) the instability of the mode with $J/\sup \pi/=0^-$ sets in before all others. In heavy nuclei the situation is similar to the situation in an infinite system; however, there also exist important differences owing to shell effects. Consideration is given to both neutral and charged channels.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 57899

57901 (BNL-NCS—50681, pp 15-28) **Differential data and experimental techniques.** Perey, F.G. (Oak Ridge National Lab., TN). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Areas are considered where the data are used mostly to assist the calculations such as transmutation reactions and other reactions contributing to the specific damage. Also the area of dosimetry is considered where most of the data come from measurements.

57902 (BNL-NCS—50681, pp 79-116) **Intense fast neutron source reactions.** Lone, M.A. (Chalk River Nuclear Labs., Ont.). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The need for intense sources of high-energy neutrons for radiotherapy and materials radiation damage studies has led to a renewed interest in the evaluation of the neutron spectral distributions and yields from charged particle induced reactions. The neutron sources for these applications need not be monoenergetic provided the average neutron energies are high enough (>10 MeV). Monoenergetic neutron sources are, however, needed for measurements of the associated nuclear data required, e.g., the neutron-induced charged-particle spectra and cross sections, and the differential elastic and inelastic neutron-scattering cross sections. In this review we compare the characteristics of various charged particle reactions capable of giving the desired neutron intensities with present-day technology.

57903 (BNL-NCS—50681, pp 453-466) **Multi-step Hauser—Feshbach codes with pre-compound effects: a brief review of current and required developments and applications up to 40 MeV.** Fu, C.Y. (Oak Ridge National Lab., TN). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

Mainly for applications to fusion energy research, several multi-step Hauser-Feshbach codes with pre-compound effects were developed. An effort to intercompare these codes by their authors is in progress. Because extensive reviews on the relevant theories have recently become available, only a few points of interest are discussed with respect to the developments and applications of these codes.

57904 (BNL-NCS—50681, pp 485-489) **He production: an example of Hauser—Feshbach calculations.** Mann, F.M.; Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

It is shown that even though it neglects direct or semi-direct terms, the Hauser-Feshbach model can predict helium production at elevated energies. Previous calculations of nuclear cross sections are compared with experimental data to verify this conclusion. 8 references. (JFP)

57905 (BNL-NCS—50681, pp 533-537) **Multi-step direct reaction approach to fit continuous spectra of nuclear reactions.** Tamura, T.; Udagawa, T. (Univ. of Texas, Austin). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

A method of fitting continuous spectra observed in various reactions induced by light and heavy ions is considered. The multistep direct-reaction theories are applied. A comparison of cross sections are shown for inelastic proton scattering on aluminium 27 and lead 209 and proton charge-exchange on lead 208. 4 references. (JFP)

57906 Role of compound-nucleus levels in forming the giant dipole resonance. Zaretskii, D.F.; Sirotkin, V.K. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 627-630(Dec 1977).

The shell-model approach to nuclear-reaction theory is used to produce an expression for the cross section for dipole photoabsorption in the neighborhood of the giant dipole resonance.

57907 Variations in charge and nucleon-density distributions and scattering of fast particles on nuclei. Burov, V.V.; Eliseev, S.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 631-633(Dec 1977).

The Glauber-Sitenko approximation is used to analyze elastic scattering of hadrons by nuclei. It is shown that if small density corrections with radial variations (as previously determined from elastic scattering of electrons) are added to the usual smooth nucleon-density distribution functions, one obtains agreement between the calculated cross sections and experimental cross sections at high momentum transfers.

57908 Optical-model analysis of elastic scattering of low-energy protons by light nuclei. Sadkovskii, V.S.; Feofilov, G.A.; Denisov, A.E.; Kolalis, R.P. (Leningrad State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 634-638(Dec 1977).

The optical model is used to analyze the angular distribution and integral cross sections for elastic scattering and absorption for 6-MeV protons scattered on all the stable nculei with A=10 to A=16. Standard optical-model parameters are used for all nuclei, with the exception of the parameter W which changes a great deal from nucleus to nucleus. W was selected on the basis of known absorption cross sections. This method of selecting the imaginary part of the optical potential gives satisfactory descriptions of the integral elastic scattering and absorption cross sections at nonresonant energies and, for some nuclei, predicts some of the features in the angular dependence of the differential cross section. Calculations using the "optical model+resonance" program have been performed near isolated resonances of the compound nucleus with the known characteristics of the resonances and including the interference between the direct optical model and the resonance processes.

57909 Partial E1 radiative strength functions of neutron resonances. Guba, V.G.; Urin, M.G. (Moscow Engineering-Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 267-273(Sep 1977).

A quantitative interpretation of the valence part of the partial E1 radiative strength functions for neutron resonances in spherical nuclei is proposed on the basis of the shell and optical models.

57910 Effects of the nuclear vertex form factor in the peripheral model. Borbei, I.; Dolinskii, E.I.; Mukhamedzhanov, A.M.; Turovtsev, V.V. (Institute of Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 274-280(Sep 1977).

The effect of the nuclear vertex form factor (NVFF) on the results of calculations of the cross sections for (p,d), (d,p), and other similar reactions in the peripheral model is analyzed within the framework of the single-particle potential model. It is shown that the NVFF effects markedly depend on the shape of the potential. The NVFF effects may be neglected for the standard Woods-Saxon shell potential.

RADIOACTIVE DECAY

57911 Phonon interaction with an odd quasiparticle and l-forbidden β transitions. Batkin, I.S.; Berkman, M.I.; Kopytin, I.V. (Voronezh State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 3, 282-285(Sep 1977).

We consider l-forbidden β transitions of odd spherical nuclei. The phonon density matrix of the even-even core is constructed and the Hamiltonian of the interaction of an odd quasiparticle with a phonon is written down within the framework of the theory of finite Fermi systems. Using a variational procedure, we obtain the explicit form of the wave functions of the ground states of the parent and of daughter nuclei. In the choice of the wave function, account is taken of only the "single-quasiparticle" and "single-quasiparticle+phonon" components. An expression for the reduced nuclear matrix element of the l-forbidden β transition is obtained within the framework of the indicated approximation. The inclusion of the "quasiparticle+phonon" state in the analysis introduces into the transition matrix element terms that are responsible for β decay without change of the orbital quantum number l. The values of log f_0t calculated for l-forbidden β transitions of the nuclei ^{65}Ni, ^{65}Zn, ^{65}Ga, ^{67}Cu, and ^{69}Ge are in better agreement with experiment than the values obtained in the single-quasiparticle approximation.

SPONTANEOUS AND INDUCED FISSION

57912 Question of non-conservation of spatial parity in the process of nuclear fission. Rabotnov, N.S. (Physics and Electrical Power Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 6, 687-688(Dec 1977).

The possibility of an increase in fission probability with parity non-conservation due to the crossing of the curves of the deformation potential is explored theoretically.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 57814

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 57698

57913 (LA—7386-MS) **Time dependence of the Compton current and energy deposition from scattered gamma rays.** Malik, J.S.; Cashwell, E.D.; Schrandt, R.G. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

The time dependence of the energy deposition and radial Compton current produced by scattered gamma rays must be known to make better use of the geomagnetic component of the radioflash signal of a nuclear explosion for diagnostic evaluation of the source. To provide a data base for empirical analytic fits to describe this dependence, a series of Monte Carlo calculations of monoenergetic gamma-ray sources in a homogeneous, isotropic air medium were performed, and the results were fitted with relatively simple and readily usable relations. The results are summarized by graphs and formulas. 8 figures.

57914 (UCRL—52459) **Measurement of energy deposited by charged particle beams in composite targets.** Crase, K.; Farley, W.E.; Kruger, H.; Selway, D.; Sidhu, G.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Nov 1977. Contract W-7405-ENG-48. 286p. Dep. NTIS, PC A13/MF A01.

The energies deposited in composite targets by proton beams from 0.8 to 28.5 GeV energy and by an electron beam at 0.5 GeV energy were measured. The targets consisted of various thicknesses of ^{238}U shower plates backed by a composite detector plate consisting of a 5-cm-thick CH_2 moderator and a 0.635-cm ^{238}U plate. The spacing between the shower and detector plates was varied to allow different spreading of the shower between plates. Passive detectors (thermoluminescence dosimeters, Lexan fission track recorders, photographic emulsions, and removable ^{238}U pieces) were used to measure the fission-fragment dose and the nonfission dose at various depths and radial positions in the targets. Plots and numerical values of the measured doses are presented for comparison with computer code calculations. To provide a basis for comparison of the effects of different particle beam energies, data along the beam axes are presented as specific dose (cal/g per incident integrated kJ/cm^2). In general, the higher the incident proton energy, the larger is the dose in the back of the target relative to that in the front.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 57902

57915 (AD-A—049496) **Operator-valued Chandrasekhar H-functions. Technical summary report.** Kelley, C.T. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Dec 1977. Contract DAAG29-75-C-0024. 15p. (MRC-TSR—1813). NTIS PC A02/MF A01.

Operator valued analogs of the Chandrasekhar H-function that occur in the study of neutron transport in a slab with continuous energy dependence and anisotropic scattering satisfy a system of nonlinear integral equations. An appropriate Banach space setting is found for the study of this system. The system may be solved by iteration. The domain of analyticity of H sub r and H sub l is extended by means of bifurcation theory.

57916 (TID—28578) **Resolved resonance processing in the AMPX modular code system.** Westfall, R.M. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). 1978. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

The energy and spatial treatments employed in the AMPX modules BONAMI, NITAWI, and ROLAIDS are described. Recommendations are made on the suitability of the various analytical models for particular applications. 3 figures, 3 tables.

57917 (TREE—1116, pp 217-221) **Data testing ENDF/B IV dosimetry data.** Harker, Y.D. Apr 1977.

In Nuclear Technology Division annual progress report for period ending September 30, 1976.

Phase II testing of the Evaluated Nuclear Data File/B Version IV (ENDF/B IV) neutron cross section data set for dosimetry applications was updated. The update involved folding energy-dependent reaction cross section data with the updated version of the neutron spectrum for the Coupled Fast Reactivity Measurement Facility (CFRMF). The new spectrum was calculated from transport theory by using a full core representation of the CFRMF and ENDF/B IV data. The derived integrated reaction rates were compared with respective measured values to determine the accuracy and limitations of the ENDF/B IV dosimetry data. The CFRMF is designated as a "benchmark" neutron field for data testing, not only on dosimetry data, but also fission product and actinide cross section data as well. A comparison of the updated version of the CFRMF spectrum, with the earlier spectrum is shown. The most pronounced change between the two spectra occurs at energies greater than 1 MeV where the new spectrum is consistently higher than the older version. This change has resulted in a significant improvement in the data testing results for the primary threshold reactions. Calculated reaction rates from three versions of the CFRMF spectrum are compared to the measured values. ENDF/B IV dosimetry reaction data were used in all calculations. 1 figure, 2 tables. (RWR)

57918 Integral equations for Wiener—Hopf factors of L_1 matrices. Gibbs, A.G. (Battelle Pacific Northwest Lab., Richland, WA). *Transp. Theory Stat. Phys.;* **6**: No. 2/3, 101-106(1977).

An elementary proof is given that the Wiener—Hopf factors of Fourier transforms of L_1 matrix-valued functions satisfy both linear and nonlinear integral equations. The matrices need not be L_2.

DOSIMETRY

REFER ALSO TO CITATION(S) 57825

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 57189, 57190

57919 Anisotropic contributions to the ground-state properties of solid para-H_2. Etters, R.D.; Danilowicz, R.; England, W. (Colorado State University, Fort Collins, Colorado). *J. Low Temp. Phys.;* **32**: No. 3, 519-528(1 Aug 1978).

The local field approximation is modified so that the translational and rotational degrees of freedom of the H_2 molecule are treated on an equal basis, when calculating the equation of state for solid para-H_2. Near normal vapor pressure the anisotropies in the H_2 pair interaction are found to make a negligible contribution to the binding energy and the equation of state, but that contribution increases with increasing pressure. However, the isotropic part of the potential plays the dominant role in determining the equation of state at all molar volumes investigated $3<$ or $=V<$ or $=22.65$ cm^3/mole. At extremely high pressures the results tend toward previous findings that were based upon a frozen $P4_2/mnm$ (γ-N_2) orientational structure.

57920 Hopping conductivity in a quasi-one-dimensional lattice gas with three-dimensional ordering. Richards, P.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B;* **18**: No. 2, 945-954(15 Jul 1978).

The dc ionic conductivity is calculated for one-dimensional (1-D) classical hopping with effects of nearest-neighbor repulsion included. Repulsion between ions in different channels which leads to three-dimensional ordering of the ions is accounted for in a mean-field manner. The intrachannel repulsion U is treated exactly by using results for the equivalent Ising antiferromagnet in a staggered field. It is shown that several choices can exist for the dependence of transition probabilities on nearest-neighbor occupation numbers and still satisfy detailed balance. In almost any case, however, the activation energy increases by U/2 as the temperature T goes through the ordering temperature T/sub c/ from above. An appreciable change in activation energy should then be observed in a 1-D superionic conductor which undergoes an order-disorder transition, provided this transition is triggered by interactions between the mobile ions. The dependence of activation energy upon U above T/sub c/ depends on the range of the forces and whether the hopping is purely classical or involves tunneling. We find that Kikuchi's result of a decrease in activation energy by U/2 from the noninteracting value is reproduced if very-short-range forces and classical activation over a barrier are assumed. On the other hand, we get Mahan's result of an increase by U/2 if the transition rate is governed by tunneling through a barrier.

57921 Level ordering of states in a Cu (001) monolayer. Painter, G.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B;* **18**: No. 2, 955-957(15 Jul 1978).

In presenting their layer multiple-scattering approach to the energy-band problem for thin films, Kar and Soven reported that the ordering of levels in their calculations for a copper monolayer differed from previous results obtained by Kasowski. Some question also arose in relating the d-level splittings at the surface to the order of the bulk E/sub g/ and T/sub 2g/ levels. In this Comment, it is suggested that these discrepancies arise from an inconsistency in coordinate systems used by Kar and Soven. It is shown that within a consistent system, the level splittings and orderings in Kar and Soven's results follow expectations based on simple bonding considerations. The resulting good agreement with other works supports the essential accuracy of the multiple-scattering approach of Kar and Soven.

57922 Statistical equilibrium spatial density in planar channeling. Ellison, J.A.; Picraux, S.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). *Nucl. Instrum. Methods;* **149**: No. 1, 429(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

SOLID STATE PLASMA

57923 (LBL—7368) Lifetime and radiative efficiency vs density in the strain-confined electron-hole liquid in Ge. Kelso, S.M.; Furneaux, J.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 17p. (CONF-780827—1). Dep. NTIS, PC A02/MF A01.

From Conference on recombination in semiconductors; Southampton, UK (30 Aug 1978).

Experiments on the electron-hole liquid (EHL) in inhomogeneously stressed Ge were performed in order to obtain information on the lifetime and radiative efficiency as a function of e-h pair density in the strain-confined electron-hole liquid (SCEHL). The data can only be explained if a density-independent recombination mechanism is the most important decay process. The result is shown to be consistent with other experiments indicating that such a mechanism has a negligible effect on the recombination time in unstressed Ge.

SUPERCONDUCTIVITY

GENERAL THEORY

57924 Structure of two-dimensional mixed state of type-I superconductors. Andreev, A.F.; Dzhikaev, Y.K. (Institute of Physics Problems, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 11, 590-594(5 Dec 1977).

It is shown that a two-dimensional-mixed-state layer produced on the inner surface of a hollow cylindrical sample carrying a sample not greatly exceeding the critical value has a macroscopic thickness and a periodic structure with a period of the order of the superconducting coherence length.

57925 Effect of hybridization on the superconductivity of transition metals. Morozov, A.I. (Moscow Physicotechnical Institute). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 719-721(Dec 1977).

Effects of s- and d-electron hybridization in a transition metal are considered. It is shown that when the Fermi level is close to the intersection point of the bands, superconductivity is due to the electron—phonon interaction of s-electrons. An expression is obtained for the superconducting transition temperature in case of weak coupling.

57926 Effect of magnetic transition-metal impurities on the tunnel characteristics of superconducting contacts. Moskalenko, V.A.; Digor, D.F. (Institute of Applied Physics, Academy of Sciences of Moldavian SSR). *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 11, 675-679(Nov 1977).

Singularities in the derivatives of the tunnel-current amplitudes in SIS' junctions are studied for the case when the superconductors constituting the junction contain magnetic transition-metal impurities. It is shown that with a forbidden energy band between the impurity band and the energy continuum the second and higher derivatives of the tunnel-current amplitudes have singularities in addition to those predicted by the Abrikosov—Gor'kov theory.

57927 Nonlinear effects during the motion of vortices in superconductors. Larkin, A.I.; Ovchinnikov, Y.N. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 155-162(Jul 1977).

The order parameter depends strongly on the coordinates in the mixed state in superconductors. A kinetic equation is derived in this case which describes the excitation-energy distribution function. This function varies strongly in a comparatively weak electric field E. At low temperatures, the effective electron temperature is proportional to E/sup 2/5/. If this temperature exceeds the energy gap, most of the energy of the stationary electric field should transform into energy of almost-monochromatic phonons. The boundary condition for the diffusion equation is obtained in the case of high impurity concentrations.

57928 Nonstationary "intermediate" state of nonequilibrium superconductors. Elesin, V.F. (Moscow Engineering-Physics Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 185-191(Jul 1977).

The character of the phase transition of an optically pumped superconductor to the normal state is investigated. It is shown that a superconductor with nonequilibrium quasiparticle is unstable relative to a transition to the normal state if the gap becomes smaller than a certain value Δ/sub n/ that is small in comparison with the gap in the absence of pumping. The region of instability with respect to the optical pumping power β coincides with the interval where the gap is not a unique function of the pump; this region was obtained by the author earlier (Sov. Phys.-JETP 44, 780, 1976). The spatially inhomogeneous states that arise after the development of the instability are investigated using the Ginzburg-Landau equation generalized to include the nonequilibrium case. Depending on the pump power, stationary coexistence of the regions of normal and superconducting phases is possible (at $\beta=\beta_0$), as well as nonstationary coexistence when the interface moves with a definite velocity that depends on the difference $\beta-\beta_0$.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 57160

57929 Sound propagation in solid superconductors. Kluge, G.; Rudat, V. (Sektion Physik der Friedrich-Schiller-Universitaet Jena, GDR). *Sov. Phys.-Acoust. (Engl. Transl.);* **24**: No. 1, 42-46(Jan 1978).

The propagation of sound waves in a solid superconductor in the presence of the Meissner effect is analyzed. The initial equations are the nonstationary Ginzburg—Landau equations and the linear elasticity equations. The ΔV and ΔC effects as well as the jump of the elastic moduli in transition through the critical temperature T/sub c/ are included in the equations. The propagation velocity and attenuation of sound are analyzed in detail. For longitudinal sound

waves the absorption coefficient exhibits a quadratic frequency dependence at low frequencies and a slower growth law at high frequencies. Transverse sound waves are unattenuated in isotropic solids and tetragonal crystals, since the only irreversible process included in the problem is relaxation of the order parameter. The calculated frequency dependence of the attenuation factor and the temperature dependence of the sound velocity are in good agreement with the experimental results.

57930 Electric field in superconductors with magnetic impurities. Shelankov, A.L. *Sov. Phys. - Solid State (Engl. Transl.);* **20**: No. 1, 166-167(Jan 1978).

It is demonstrated theoretically that magnetic impurities can significantly reduce the penetration depth in a superconductor. (AIP)

57931 Response of a squid of finite junction width to an external magnetic field. Shmidt, V.V.; Stelmakh, V.G. *Sov. J. Low Temp. Phys. (Engl. Transl.);* **3**: No. 12, 722-723(Dec 1977).

A theoretical analysis is made of how a hollow superconducting cylinder shorted with a finite-width Josephson junction responds to an external magnetic field. The total magnetic flux Phi in the cylinder is studied as a function of the external magnetic flux Phi/ sub x/ introduced into the cylinder. A qualitative method is proposed for analysis of the dependence of Phi on Phi/sub x/. The stability of states of a cylinder with flux Phi is studied and the results of a numerical calculation of the stability are presented.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

57932 Laplace transforms of Heisenberg operators in finite-dimensional spaces. Dzheparov, F.S. (Institute of Theoretical and Experimental Physics, State Commission on Use of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **25**: No. 5, 592-593(May 1977).

The integral X (λ) = ∫/sup infinity/$_0$ dt exp[-(λ-iF) t]X exp(-iHt) and the solution to the matrix equation (λ-iF) X (λ)+iX (λ) H=X, where F and H are Hermitian matrices of dimensionality M and N, respectively, are written as polynomials of order N-1 in H and M-1 in F. The coefficients are determined from the characteristic polynomials of the matrices F and H.

STATISTICAL PHYSICS AND THERMODYNAMICS

57933 Brownian dynamics with hydrodynamic interactions. Ermak, D.L.; McCammon, J.A. (Biomedical and Environmental Research Division, Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Chem. Phys.;* **69**: No. 4, 1352-1360(15 Aug 1978).

A method for simulating the Brownian dynamics of N particles with the inclusion of hydrodynamic interactions is described. The particles may also be subject to the usual interparticle or external forces (e.g., electrostatic) which have been included in previous methods for simulating Brownian dynamics of particles in the absence of hydrodynamic interactions. The present method is derived from the Langevin equations for the N particle assembly, and the results are shown to be consistent with the corresponding Fokker—Planck results. Sample calculations on small systems illustrate the importance of including hydrodynamic interactions in Brownian dynamics simulations. The method should be useful for simulation studies of diffusion limited reactions, polymer dynamics, protein folding, particle coagulation, and other phenomena in solution.

ELECTRICITY AND MAGNETISM

57934 (UCID—17814) **JASON—a code for solving general electrostatics problems. User's manual.** Sackett, S.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jun 1978. Contract W-7405-ENG-48. 54p. Dep. NTIS, PC A04/MF A01.

JASON solves general electrostatics problems having either slab or cylindrical symmetry. More specifically, it solves the self-adjoint elliptic equation, div . (KgradV) - γV + rho = 0 in an aritrary two-dimensional domain. For electrostatics, V is the electrostatic potential, K is the dielectric tensor, and rho is the free-charge density. The parameter γ is identically zero for electrostatics but may have a positive nonzero value in other cases (e.g., capillary surface problems with gravity loading). The system of algebraic equations used in JASON is generated by the finite element method. Four-node quadrilateral elements are used for most of the mesh. Triangular elements, however, are occasionally used on boundaries to avoid severe mesh distortions. 15 figures. (RWR)

57935 (UCRL—13852-2) **Dielectrophoretic levitation of spheres and shells.** Kallio, G.A.; Jones, T.B. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

Strong nonuniform electric fields exert a force on uncharged polarized dielectric particles. Under certain conditions, this dielectrophoretic effect can be used to levitate particles or bubbles in dielectric liquids. For a particle with induced polarization, an effective dipole moment may be defined which indicates the strength of the induced electrostatic dipole field and serves as the effective dipole upon which the dielectrophoretic force is exerted. The effective dipole moment is calculated for small solid spheres and shells of insulating and conducting dielectric material. Steady-state dc and ac solutions are obtained. The step response to a suddenly applied dc electric field is also determined. The steady-state ac case is characterized by a cutoff frequency which determines whether levitation is possible for certain types of particles. In the experiments, spheres and shells of various materials are levitated in ac and dc electric fields using a cusped electric field. A fixed electrode structure is calibrated by use of a dielectric liquid with known properties, and the quantitative results of numerous levitation experiments are favorably compared to the theoretical model. The frequency-dependent behavior of glass microballoons is found to be generally consistent with the predictions of the model. Results with dc electric fields are inconclusive due to electroconvection, electrostatic repulsion, and long charge relaxation time constants. 5 figures, 5 tables.

57936 (UCRL—52423) **SOMINT: an improved model for studying conducting objects near lossy half-spaces.** Brittingham, J.N.; Miller, E.K.; Okada, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Feb 1978. Contract W-7405-ENG-58. 96p. Dep. NTIS, PC A05/MF A01.

This report summarizes the development of a moment-method numerical code to study wire antennas near lossy earth. The computation time of this code is greatly reduced by two new methods for evaluating the Sommerfeld integrals. In the evaluation of the integrals off the earth, a bivariate interpolation scheme on a prestored grid is shown to give very quick and accurate results. A new series solution is presented to evaluate the integral for values near the interface. Test results of this program are given, along with extensive numerical data on vertical half-rhombic and sloping V antennas. 93 figures, 3 tables.

FUSION ENERGY

57937 (MATT—1(Suppl.4)) **Bibliography of Plasma Physics Laboratory: publications and reports. Period covered: January 1, 1976—December 31, 1977.** (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1978. Contract EY-76-C-02-3073. 30p. Dep. NTIS, PC A03/MF A01.

57938 (PNL-SA—6492) **Perspective on the fusion-fission energy concept.** Liikala, R.C.; Perry, R.T.; Teofilo, V.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 54p. (CONF-780222—7). Dep. NTIS, PC A04/MF A01.

From 5. energy technology conference; Washington, DC, USA (27 Feb 1978).

A concept which has potential for near-term application in the electric power sector of our energy economy is combining fusion and fission technology. The fusion-fission system, called a hybrid, is distinguished from its pure fusion counterpart by incorporation of fertile materials (uranium or thorium) in the blanket region of a fusion machine. The neutrons produced by the fusion process can be used to generate energy through fission events in the blanket or produce fuel for fission reactors through capture events in the fertile material. The performance requirements of the fusion component of hybrids is perceived as being less stringent than those for pure fusion electric power plants. The performance requirements for the fission component of hybrids is perceived as having been demonstrated or could be demonstrated with a modest investment of research and development funds. This paper presents our insights and observations of this concept in the context of why and where it might fit into the picture of meeting our future energy needs. A bibliography of hybrid research is given.

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

57939 (AD-A—049505) **Theory of electron energy confinement in tokamaks. Interim report.** Manheimer, W.M.; Antonsen, T. Jr. (Naval Research Lab., Washington, DC (USA)). Oct 1977. Contract ES-77-A-01-6021. 29p. (NRL-MR—3551). NTIS PC A03/MF A01.

A one dimensional thermal transport code has been employed to study electron energy confinement in tokamaks. At each time step

of the computations each point in the profile is examined to determine whether it is linearly stable to either the dissipative trapped electron mode or the internal kink and tearing modes. If the point is determined to be unstable an anomalously large electron thermal conductivity is turned on in the vicinity of that point. The electron temperature profile is found to relax to a marginally stable state. Our code predicts the scaling of confinement time with density in Alcator, and the scaling of temperature half-width with q(a) in TFR. (Author)

57940 (AEOI—60) **End losses from linear theta pinches.** Azodi, H. (Atomic Energy Organization of Iran, Teheran. Nuclear Research Centre). Sep 1977. 15p. (NRC—76-38). Dep. NTIS (US Sales Only), PC A02/MF A01.

A model is proposed for studying, in steady state approximation, the effects of viscosity on the velocity of the rarefraction wave in a linear Theta plasma. This velocity can be used to describe particle end losses in a linear theta pinch. As expected, the inclusion of the viscous term in the equation of motion reduced the estimated value of the wave velocity, resulting in an increased containment time. The model indicates that wave velocity is reduces as the plasma pressure approaches the external magnetic pressure, and that for approximately equal values wave velocity is reduced by a factor of two. There is good agreement between this model and available experimental results.

57941 (KIYI—76-4) **Generation of dense-plasma fast flows while laser irradiation of a solid target.** Oraevskii, V.N.; Shamrai, K.P. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1976. 11p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A method is proposed to generate fast and dense plasma flows while laser irradiation of a target of special geometry, where the effect of cumulative speed-up of substance takes place.

57942 (Rijnhuizen—77-106) **Current-driven turbulence in plasmas.** de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Oct 1977. 103p. Dep. NTIS (US Sales Only), PC A06/MF A01.

Research on plasma heating in linear and toroidal systems using current-driven turbulence is reviewed. The motivation for this research is presented. Relations between parameters describing the turbulent plasma state and macroscopic observables are given. Several linear and toroidal devices used in current-driven turbulence studies are described, followed by a discussion of special diagnostic methods used. Experimental results on the measurement of electron and ion heating, anomalous plasma conductivity and associated turbulent fluctuation spectra are reviewed. Theories on current-driven turbulence are discussed and compared with experiments. It is demonstrated from the experimental results that current-driven turbulence occurs not only for extreme values of the electric field but also for an experimentally much more accessible and wide range of parameters. This forms a basis for a discussion on possible future applications in fusion-oriented plasma research.

57943 **Plasma return current discharge.** Mangano, J.A.; Hsia, J.; Jacob, J.H.; Srivastava, B.N. (Avco Everett Research Laboratory, Inc., Everett, Massachussetts 02149). *Appl. Phys. Lett.;* **33**: No. 6, 487-489(15 Sep 1978).

A discharge technique based on the use of an electron-beam-induced plasma return current to produce and heat large-volume plasmas is described. The results of discharge studies using this technique in attachment-dominated mixtures are presented. The results are found to be adequately described by a simple theory. The electron attachment rate by F_2 inferred from these measurements agrees well with those of other workers. KrF laser action at 248 nm is reported in return-current discharge-excited mixtures of F_2/Kr/He.

57944 **Charged-particle injection into an electrostatically plugged magnetic confinement device.** Yushmanov, E.E. (I. V. Kurchatov Institute of Atomic Energy, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 11-17(Jan 1978).

The injection of particles into a magnetic confinement system from the top of the potential barrier is studied. The distribution function acquires an excessive number of particles near the maximum energy, so the escape of particles across the barrier is enhanced. This escaping flux is found as a function of the injection current and the extent to which the plasma is collisional. Only a fraction, usually small, of the total injected current is effectively confined; the rest of the current is "reflected." The trapping coefficient becomes smaller as the plasma becomes less collisional. The energy loss from the confinement device due to energy transport across the barrier is also studied. It is found that the reflected current is extremely important as an additional mechanism for cooling the confined plasma.

57945 **Behavior of runaway electrons in the Tuman-2 device.** Kaganskii, M.G.; Kalmykov, S.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 18-21(Jan 1978).

The runaway electrons in a tokamak with plasma compression by an increasing toroidal field have been studied on the basis of the hard x-ray emission which they excite by moving the plasma with a rapidly varying transverse field it was found that the runaway electrons usually lie within ~1 cm of the plasma surface in the ohmic-heating stage. Certain characteristics of the instability which causes the oscillations in the x-ray intensity can be determined from these oscillations. When the plasma is compressed by a toroidal magnetic field, the energy of the runaway electrons increases from 400—500 keV to 1 MeV in ~100 μsec. This increase cannot be explained solely on the basis of a longitudinal acceleration of electrons. It is suggested that these electrons have a high transverse energy, which increases as the toroidal field increases during the compression.

57946 **Contraction of the current channel in the Tuman-2 tokamak.** Kaganskii, M.G.; Kalmykov, S.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 21-26(Jan 1978).

The changes in the effective radius of the current channel during magnetic compression of a toroidal plasma are reported. These changes were found by analyzing the inductive component of the torus loop voltage. In macroscopically stable discharges, the current is nearly "frozen into" the plasma. With a threefold compression, it is thus possible to produce a current channel with a diameter which is 0.4 of the limiter diameter. Deviations from the "frozen-instate" in unstable discharges and in the later stage of the compression in stable discharges are due to diffusion of the current channel, which is described by the classical diffusion coefficient D/sub I/ $=c^2 4\pi\sigma$. Fine-scale oscillations are suppressed in the plasma upon compression, apparently because of the increase in the electron temperature.

57947 **Initial stage of the discharge in a tokamak.** Mirnov, S.V.; Semenov, I.B. (I. V. Kurchatov Institute of Atomic Energy, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 27-32(Jan 1978).

The initial stage of the discharge in the T-3 and T-4 tokamaks is analyzed. Previous arguments regarding the growth of MHD waves in the quasisteady stage of the discharge can be extended to the initial stage. Depending on the plasma density, there are two possible mechanisms for the contraction of the current channel. For discharges at low and intermediate densities (in the T-4, with H/sub z/=26 kOe, Z-bar/sub eff/~6 and u~6 V), n/sub e/< or $=3.5\times10^{13}$ cm^{-3}, the main reason for this contraction is the increase in the transport coefficients due to the growth of MHD perturbations of higher-order modes at the plasma boundary. At high densities, n/sub e/>3.5×10^{13} cm^{-3}, the main reason for the contraction is the ionizational and radiative cooling of the plasma periphery due to the limited ohmic-heating power and the subsequent growth of lower-order MHD modes. This latter circumstance also restricts the maximum plasma density which can be achieved.

57948 **Quasi-linear model for ion cyclotron heating of tokamaks and mirrors.** Kesner, J. (Wisconsin Univ., Madison (USA)). *Nucl. Fusion;* **18**: No. 6, 781-790(1978).

A quasi-linear numerical model for RF heating is developed in a form so as to be applicable both to tokamak and to magnetic mirror plasma confinement devices. It is then combined with a two-dimensional multi-species Fokker-Planck code to yield detailed information on the distortion of the ion distribution function due to an imposed level of RF. For a two-component tokamak, it is found that while "fast-wave" ion heating will not increase the fusion output, as much as 40% of the beam power may be replaced by RF in a strongly driven two-component tokamak without significantly degrading the fusion output. For magnetic mirror devices, results indicate that RF in combination with relatively low-energy beams may be expected to heat the ions to well above the beam injection energy as well as to increase confinement.

57949 **Wave heating of an ion beam in a tokamak plasma.** Kritz, A.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.; Hunter Coll., New York (USA)); Mahajan, S.M. (Texas Univ., Austin (USA)); Berger, R.L. (KMS Fusion, Inc., Ann Arbor, Mich. (USA)); Goldston, R.J.; Motley, R.W.; Hooke, W.M.; Bernabei, S. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nucl. Fusion;* **18**: No. 6, 835-841(1978).

Heating of a 26-keV trapped-ion beam by interaction with incident lower-hybrid RF power (as low as 5kW) was observed in the ATC plasma. We suggest that ion-cyclotron damping of lower hybrid waves by beam ions can account for the increase in beam energy. This process can explain the main features of the experiment: (1) preferential absorption in the perpendicular direction, (2) lack of absorption by the background plasma ions, and (3) low power requirement for absorption. Theory requires ksub(perpendicular)rhosub(i) approximately > (ω/ωsub(ci))sup(1/

2). The relatively high perpendicular temperature of the beam ions (approximately 1keV), combined with one of several possibilities for RF energy at large ksub(perpendicular), allows the condition on ksub(perpendicular)rhosub(i) to be satisfied. Moreover, the large parallel energy of the beam ions plays a major role in broadening the harmonic resonances, thus making it possible for a large number of beam ions to resonate with the wave. Though the primary process is perpendicular absorption, there is also a net gain in parallel energy during a collision time due to pitch-angle scattering. The importance of this heating mechanism for large machines such as TFTR is discussed. For these machines, ions will be injected with large rhosub(i), making ion heating possible even with moderate values of ksub(perpendicular).

57950 Formation of high-density z-pinches. Potter, D. (Imperial Coll. of Science and Technology, London (UK)). *Nucl. Fusion;* **18**: No. 6, 813-823(1978).

Three regimes in the formation of a simple pinch are delineated. For a rapidly rising current, the formation of the pinch by a strong shock is first considered. A slug model is developed which, unlike the snowplough model, describes the radial structure between piston and shock. The final equilibrium pinch is described and radial profiles of density and temperature are obtained. Under the conditions of a strong shock, a weakly compressed pinch is formed in which the pinch radius is related to the wall radius and is independent of the current applied. By programming the current in time, regimes of singular compression and adiabatic compression can be obtained. A much more highly compressed plasma is produced. Such a current profile can readily be produced by a line storage energy source.

57951 Intensive transverse transport of fast electrons in a tokamak. Gurevich, A.V.; Dimant, Y.S.; Dnestrovskii, Y.N.; Razumova, K.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences; I. V. Kurchatov Institute of Atomic Energy). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 11, 569-572(5 Dec 1977).

An intensive departure of electrons having an energy exceeding T/sub e/ by one order of magnitude, from the center of a tokamak plasma pinch towards its peripheral regions has been observed.

57952 Heating of a dense plasma at parametric cyclotron resonance. Golovanivskii, K.S.; Punithavelu, A.M. (Patrice Lumumba Univ., Moscow (USSR). Plasma Phys. Lab.). *Plasma Phys.;* **19**: No. 12, 1145-1150(Dec 1977).

The penetration of the field of a standing electromagnetic wave of the mode H_{011} excited in a cylindrical cavity into a plasma column, placed along the symmetry axis of the e.m. field, is experimentally studied. It is shown that, the field with such a configuration penetrates, without appreciable distortion, into a plasma with lower as well as much higher than the cut-off density. In the present experiments we could succeed in reaching up to n/nsub(cut-off) approximately 10^2 where the complete penetration of the h.f. field into the plasma was registered. The h.f. heating of a plasma, with the density exceeding the cut-off value by two orders, has been achieved at the conditions of parametric cyclotron resonance for electrons ($\omega = 2\omega$sub(ce)).

57953 Radio frequency sustained ion energy. Jassby, D.L.; Hooke, W.M. (to Energy Research and Development Administration). US Patent 4,057,462. 8 Nov 1977. Filed date 26 Feb 1975. 10p. PAT-APPL-553,196.

Electromagnetic (E.M.) energy injection method and apparatus for producing and sustaining suprathermal ordered ions in a neutral, two-ion-species, toroidal, bulk equilibrium plasma are described. More particularly, the ions are produced and sustained in an ordered suprathermal state of existence above the average energy and velocity of the bulk equilibrium plasma by resonant rf energy injection in resonance with the natural frequency of one of the ion species. In one embodiment, the electromagnetic energy is injected to clamp the energy and velocity of one of the ion species so that the ion energy is increased, sustained, prolonged and continued in a suprathermal ordered state of existence containing appreciable stored energy that counteracts the slowing down effects of the bulk equilibrium plasma drag. Thus, selective deuteron absorption may be used for ion-tail creation by radiofrequency excitation alone. Also, the rf can be used to increase the fusion output of a two-component neutral injected plasma by selective heating of the injected deuterons. 1 claim, 5 figures.

57954 ECR plasma in poloidal heliotron type magnetic field. Sakamoto, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). *Jpn. J. Appl. Phys.;* **16**: No. 8, 1409-1415(Aug 1977).

Helium plasmas are produced by pulsed electron cyclotron resonance discharge in a poloidal heliotron type magnetic field which is a minimum average B field. The maximum plasma parameters are T sub(e) asymptotically equals 10 eV, T sub(i) asymptotically equals 10 eV and N sub(e) asymptotically equals 6 x 10^{11} cm^{-3}. We can obtain plasmas of low fluctuation and of a uniform radial density distribution, which are useful from the practical viewpoint to test plasmas for plasma researches or ion source plasmas in the case of a multiple-aperture extraction type.

57955 Perspectives of electron cyclotron wave application for large tokamak heating. Alikaev, V.V.; Dnestrovskii, Yu.N.; Parail, V.V.; Pereverzev, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 230-238(Mar-Apr 1977). (In Russian).

It is shown that in hot plasma of a tokamak the principal mecanism of the energy losses of electromagnetic waves with a frequency close to ωsub(He) is cycloron damping of the wave in the region of $\omega = \omega$sub(He). In a quasiinclassical approximation numerical calculations have been made of wave trajectories and absorption of their energy along the trajectories for facilities presently in use and those of the next generation. It is also shown that with right selection of conditions for the wave input its energy is absorbed in the plasma filament center and is spent for heating the bulk of electrons.

57956 Excitaion of slow transverse magnetic waves for plasma heating in the low hybrid frequency range. Baranov, Yu.F.; Shcherbinin, O.N. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 246-255(Mar-Apr 1977). (In Russian).

A linear problem of excitation of slow waves in a plasma is considered. The antenna system includes a set of waveguides opening at the level of a wall confining the plasma. The waveguides are oriented in such a manner as to excite an E wave having a singularity near the lower hybrid resonance. The boundary conditions on the plasma surface have been defined with due account for wave propagation in the inhomogeneous plasma of the peripheral region. Reflection factors and plasma absorption spectra depending on the size and number of waveguides, plasma parameters and chamber wall impedance have been obtained. It is shown that the spectrum of waves penetrating into inner layers of the plasma is achieved with a great number of radiating waveguides, irrespective of the wall impedance. The optimum spectrum can also be achieved with only two waveguides provided proper corrugation of metal walls of the chamber.

57957 Collective processes in the fast neutral atom injection into a tokamak with noncircular cross-section. Bardakov, V.M.; Mikhailovskii, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 220-229(Mar-Apr 1977). (In Russian).

Collective processes are studied which may take place when a fast neutral atom beam is injected into a tokamak of noncircular section. It is assumed that the processes are associated with build up of Alfven waves by fast ions produced during neutral atom ionization. The linear increment of the Alfven waves in a tokamak of noncircular section is calculated with due account for a poloidal dependence of a poloidal megnetic field. An O'Neil type problem is solved for a noncircular tokamak. Equations have been obtained, describing the quasilinear relaxation of fast ions in noncircular tokamak. The conclusion is made that the noncircularity of the tokamak's section may be responsible for additional instability branches and additional non-Coulomb relaxation processes.

57958 Charged particle diffusion in joule heating in the "Uragan-2" stellarator. Konovalov, V.G.; Kotsubanov, V.D.; Kravchin, V.V.; Pavlova, G.P.; Pavlichenko, O.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 311-320(Mar-Apr 1977). (In Russian).

The review deals with particle diffusion in the case of Joule heating of plasma. The results of measuring the lifetime of charged particles for helium plasma in the "Uragan-2" stellarator are given. The plasma characteristics are as follows: electron density of (0.2-1.2) x 10^{10} cm^{-3}, electron temperature up to 300 eV confining magnetic field up to 22 kOe. It has been established that the particle diffusion in the case of current heating in the intermediate frequency range exceeds the neoclassical one by one order of magnitude, i.e., it is anomalous. The possible causes of the anomalous diffusion such as plasma turbulence due to the drift-gravitational instability, as well as inversion of the "pinch-effect" of trapped particles are discussed.

57959 Hard X radiation during joule heating in the "Uragan-2" stellarator. Pavlichenko, O.S.; Tereshchenko, F.F.; Tonkopryad, V.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 321-328(Mar-Apr 1977). (In Russian).

The dynamic of hard X radiation accompanying ohmic discharges in a stellarator is studied. Studying hard gamma quanta (Esub(γ) = 0.05-5 MeV) is prompted by interaction of run away electrons with a wall of the vacuum chamber. There has been proposed a picture describing the dynamics of X-ray activity of the discharges, including "classical" mechanisms of collisionless transport of energetic electrons to the wall (diffusion of magnetic force lines and drift of run away electron orbits), as well as a mechanism

involving production of islands and breakup of magnetic surface in regimes of the tearing instability. The limited lifetime associated with the processes determines the limiting energy of accelerated electrons and in regimes of developed instability leads to suppression of the X-ray activity of the discharges.

57960 Calculation of exciting systems for rf plasma heating in the low hybrid frequencies range. Piliya, A.D.; Fedorov, V.I.; Shcherbinin, O.N.; Dyatlov, J. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). *Fiz. Plazmy;* **3**: No. 2, 256-262(1977). (In Russian).

The paper is concerned with boundary conditions in the problem of excitation of slow waves in an inhomogeneous plasma, in the range of the lower hybrid resonance frequencies. It is shown that for weak deceleration when the condition of accessibility of deep plasma layers is not met, pronounced interpenetration of E and H waves takes place, and the boundary conditions on the surface take a matrix form. The results of calculating matrix coefficients are given along with an asymptotic solution.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 58025

57961 (UCRL—80922) **Space-charge temporal broadening effects in streak-camera tubes.** Kalibjian, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 May 1978. Contract W-7405-ENG-48. 6p. (CONF-780804—5). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

An electron space-charge model has been developed that explains the temporal broadening effect in streak-camera tubes. The validity of the model is demonstrated for the Photochron I tube.

57962 (UCRL—80923(Rev.1)) **Design considerations in ultrafast electron-optical imaging tubes.** Kalibjian, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1978. Contract W-7405-ENG-48. 6p. (CONF-780804—7). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

Electron-optical design parameters are investigated with respect to optimizing dynamic range and temporal and spatial resolution in streak- and framing-camera tubes.

57963 (UCRL—81099) **Laser fusion diagnostics.** Coleman, L.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 May 1978. Contract W-7405-ENG-48. 108p. (CONF-780552—3). Dep. NTIS, PC A06/MF A01.

From Conference on plasma science; Monterey, CA, USA (15 May 1978).

The current status of the capability of laser fusion diagnostics is reviewed. Optical and infrared streak cameras provide one time resolution measurement capability of less than 10 ps, while x-ray streak cameras provide 15 ps time resolution in the range of about 1—30 keV presently. Time integrated spatial resolutions of 1 μm are provided with a variety of optical techniques. Ultraviolet holographic interferometry has measured electron densities above 10^{21} cm^{-3} with 1 μm spatial resolution and 15 ps temporal resolution. X-ray microscopes provide 3 μm time integrated resolution and the x-ray streak pinhole camera has 6 μm spatial resolution. Development of the framing camera has thus far provided 50 μm spatial resolution with 125 ps frame duration and the third order reconstruction of zone plate images has provided 3 μm resolutions for alpha particles. Time integrated measurements of x-rays span the range shown. Finally, the new Shiva neutron spectrometer increases the energy resolution capability of that technique to 25 keV for 14-MeV neutrons. These combined capabilities provide a unique set of diagnostics for the detailed measurement of the interaction of laser light with targets and a subsequent performance of those targets.

57964 Measurements of the ion-expansion structure and velocities from thin-foil laser-target interactions. Gusinow, M.A.; Anthes, J.P.; Matzen, M.K.; Woodall, D. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Appl. Phys. Lett.;* **33**: No. 9, 800-802(1 Nov 1978).

Energetic 8-nsec laser pulses were focused on Al, Au, and Cu foils ranging in thickness from 0.1 to 9 μm. The transmitted laser light was recorded and the plasma expansion from the front and back surfaces of these foils was measured using Thomson parabola and Faraday cup diagnostics. Comparison of the front- and back-surface Thomson parabola traces clearly shows the change from ablatively driven behavior to nearly symmetric exploding-pusher behavior for all of the materials.

57965 Perturbation of plasma potential caused by probe or grid in a plasma. Nakamura, Y.; Nomura, Y. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). *Phys. Lett., A;* **65**: No. 5, 415-417(3 Apr 1978).

Low-frequency signals applied to a grid excite a direct coupled signal to a receiver which is due to a change of the plasma potential. The change is caused by absorption of electrons by the grid.

57966 Michelson interferometer with a CO_2 laser for measuring plasma densities. Burmasov, V.S.; Kruglyakov, E.P.; Podyminogin, A.A. (Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 79-81(Jan 1978).

A classical Michelson inteferometer with a CO_2 laser has been developed for measuring plasma densities. Since there is no inherent laser—interferometer feedback, it is possible to achieve a time resolution tau $\sim$ 30 nsec for the interferometer. This time resolution is governed by that of the detector. The detector is a Ge:Au photoresistance, cooled with liquid nitrogen. The range in which the interference signal (δJ) is a linear function of the electron density (n/sub e/) is found for small phase shifts. The linear relation n/sub e/1=3.4 x 10^{15} J/J_0 is derived. Here J_0 is the signal amplitude at the interference maximum. This equation holds for phases from 0.2π to 0.7π. The interferometer and the single-mode CO_2 laser are described in detail. Measurements of n/sub e/ in the GOL-1 device are reported. The sensitivity of the interferometer is found to be n/sub e/1$\simeq 10^{12}$ cm^{-2}.

57967 Probe diagnostics of time-varying plasmas at high pressures. Novikova, K.P.; Ul'yanov, K.N. (V. I. Lenin All-Union Electrotechnical Institute). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 81-85(Jan 1978).

Analytic equations are derived to relate the ion current drawn by the probe to the properties of the time-varying plasma. The cases of plane, cylindrical, and spherical probes are considered. Simple equations, convenient for practical use, are found. Analysis of the ion branch of the probe characteristic makes it possible to find both the charged-particle density and the effective ionization and recombination coefficients in the plasma.

57968 Measurement of the electron velocity distribution function in a plasma jet. Medvedev, Y.A.; Sorokin, V.M.; Stepanov, B.M.; Fedorovich, G.V. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 1, 38-40(Jan 1978).

A method is proposed for determining the characteristics of the axially symmetric, electron velocity distribution function in a nonrelativistic plasma flow by measuring the spectral distribution of scattered light.

57969 Study of a laser-produced plasma by Langmuir probes. Chang, C.T.; Hashmi, M.; Pant, H.C. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). *Plasma Phys.;* **19**: No. 12, 1129-1138(Dec 1977).

The structure, the parameters and the expansion of the plasma produced by focusing a 7J, 20 ns Nd-glass laser on stainless-steel and glass targets suspended in a high-vacuum chamber were investigated by Langmuir probes. It was observed that the probe signals consisted of a photoelectric-emission peak and the main plasma from the target. The flow velocity, density and electron temperature of the plasma were determined. The expansion of the plasma was found to be adiabatic, yielding gamma = 5/3. The spatial distribution of the plasma was observed to be strongly anisotropic.

57970 Spectral intensity and profile of scattering radiation from an inhomogeneous plasma. Hayase, K. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch). *Plasma Phys.;* **19**: No. 12, 1151-1161(Dec 1977).

The intensity and profile of the scattering spectrum of electromagnetic wave from a plasma with inhomogeneous temperature and density is calculated. The total scattering intensity does not change noticeably in the experimental conditions. However, the spectral profiles are strongly affected except in a few cases. A method for estimating the mean temperature and density is also discussed.

57971 Probe diagnostics of cool plasmas in a magnetic field. III. Electron saturation current of the probe characteristic. Baksht, F.G.; Dyuzhev, G.A.; Tsirkel', B.I.; Shkol'nik, S.M.; Yur'ev, V.G.; Antonov, S.V.; Vainberg, L.I.; Kazanets, G.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 11, 1313-1319(Nov 1977).

An experimental study of the electron saturation current drawn by a probe in a magnetic field for various degrees of plasma ionization is reported. The experimental results are compared with calculations carried out for weakly and highly ionized plasmas.

57972 Electron temperature in the plasma stream from a Hall accelerator. Bugrova, A.I.; Daneliya, I.A.; Ermolenko, V.A.; Kalikhman, L.E. (Moscow Institute of Radio Engineering, Electronics, and

Automation). *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **22**: No. 11, 1337-1338(Nov 1977).

The electron temperature in the stream from the plasma source is determined experimentally by a xenon "optical thermometer." It is shown that the electron temperature determined by the relative-intensity method on the basis of the corona model agrees with the results of probe measurements if the effective excitation cross section is averaged over a Druyvesteyn distribution.

57973 Determination of electron temperatures during initial phases of tokamak discharges by an improved time-history method of spectral lines. Kasai, S.; Funahashi, A.; Sugie, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Mori, K. *J. Phys. Soc. Jpn.;* **43**: No. 1, 310-317(Jul 1977).

Temporal variations of intensities of spectral lines in a normal-incidence vacuum ultra-violet region emitted from oxygen and carbon impurities of tokamak plasmas have been studied both experimentally and theoretically. Experimental results have been compared with theoretical ones calculated numerically by using a plasma model involving ionization, radiative and dielectronic recombinations, finite confinement times of impurity-ions, and influxes of neutral impurities from walls. The initial rise of electron temperature has been estimated in such a way that the peak-times for spectral lines in successive states of ionization coincide in both experimental and numerically-calculated results. The estimated electron temperatures are found to be consistent with those obtained from measurement of ruby-laser light scattering and soft X-ray spectra.

57974 Modified theory of the floating double probe and a renewed method for determining the plasma electron temperature. Dote, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)); Ohuchi, M.; Kawase, H. *Rikagaku Kenkyusho Hokoku;* **53**: No. 3, 62-69(May 1977). (In Japanese).

A mistake has been found in the theoretical treatment, in the article on the floating double probe method which was reported by Dote in 1968. In the present paper, the theory is modified and on the basis of this theory, a renewed method for determining the electron temperature from the current-voltage characteristics of the floating double probe is also presented, where a diagram and a table of figures convenient for the calculation are prepared. Moreover errors in the values of the electron temperature obtained by using the old theory are estimated.

57975 Langmuir probes study of the region near a wall on the TM-3 tokamak. Bobrovskii, G.A.; Kondrat'ev, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 209-212(Mar-Apr 1977). (In Russian).

Double electric probes are used in measuring the electron temperature and density along filament radius in the shadow of the diaphragm confining the plasma filament in a tokamak. It is shown that in the immediate proximity to a wall the electron density is several times 10^{10} cm^{-3} and does not vary with the initial pressure and discharge current. Oscillations in the saturation current have sharp maxima as the probe passes through the resonant magnetic surfaces in the shadow of the diaphragm. It is assumed that the oscillations are responsible for additional escape of charged particles on the chamber wall as well as additional desorption.

57976 Technique for measuring soft X radiation spatial in the Tokamak-4. Vershkov, V.A.; Mirnov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 197-199(1977). (In Russian).

A technique for measuring the spatial distribution of soft X-ray radiation is proposed, based on multiple scanning of the radiation in the course of the process. The basic element in the instrument is a rotary diaphragm whose design permits sequential scanning of the filament radiation with various absorbers and thereby determining the distribution of electron temperature. At a filament radius of 17 cm the spatial resolution is 3.5 cm. A similar system is used to measure the position of a plasma filament in the chamber.

PLASMA KINETICS - GENERAL

57977 Annual review of the Institute of Plasma Physics, Nagoya University, for fiscal 1976. *Nagoya Univ., Inst. Plasma Phys., Annu. Rev.;* No. 1976, 1-152(1977).

Achievements of the IPP from April 1976 to March 1977 are described in individual short reports, featuring the following: experiments with hybrid stellarator/tokamak JIPP T-II, nonlinear transport due to collisional drift wave, plasma confinement of Nagoya High Beta Toroidal Pinch Experiments, thermonuclear fusion plasma by lasers coupling and implosion, high-temperature high-quality deuterium plasma production by laser beams, high current REB ring for plasma confinement, and plasma confinement in a cusp field with RF plugging.

PLASMA KINETICS - EXPERIMENTAL

57978 Plasma impedance measurements at the lower hybrid frequency. Ballard, W.P.; Rosenthal, S.E.; Ihic, D.B.; Crawford, F.W. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). *Phys. Lett., A;* **65**: No. 5, 408-410(3 Apr 1978).

Plasma impedance measurements have been made in the frequency range around the lower hybrid frequency, by plotting the complex reflection coefficient as the frequency was varied. As demonstrated by comparison with the calculated values of the lower hybrid frequency, this inherently non-perturbing technique is a sensitive indication of the occurrence of lower hybrid resonance in the plasma.

57979 Plasma line broadening of the Lyman-α transition including ion dynamics. Lee, R.W. (Imperial Coll. of Science and Technology, London (UK)). *J. Phys., B (London);* **11**: No. 6, L167-L169(28 Mar 1978).

The discrepancy between theory and experiment reported by Grutzmacher and Wende (Phys. Rev.; A16:243 (1977)) for the central region of the profile of the hydrogen n = 2 to n = 1 transition is explained. A calculation shows that the mechanisms causing the observed additional broadening are the ion dynamic contributions to the profile.

57980 Correlation between the pulses of penetrating radiation and the electrical characteristics of a plasma-focus discharge. Pavlovskii, A.I.; Suvorov, V.N.; Potikha, V.I.; Tulin, N.A. *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 3-5(Jan 1978).

Pulses neutrons and x rays were measured along with the electrical properties of the final stage discharge in a device with an energy ~100 J at currents α1 MA, with integrated neutron yields $\sim 10^{10}$ n/pulse in deuterium. Semiconductor detectors revealed x rays with an effective energy ~25 keV. The source positions were studied by the pinhole camera method. Under certain discharge conditions there are repeated pulsations in the voltage, and the x-ray emission. The fine structure of the x-ray image of the source is compared with these pulsations.

57981 Microwave emission in the PETULA and WEGA devices. Rozhdestvenskii, V.V. the PETULA Group, and the WEGA Group. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 33-39(Jan 1978).

The plasma microwave emission has been studied in the PETULA and WEGA devices. When the beam of accelerated electrons appears in the initial stage of the discharge, there is nonequilibrium synchrotron radiation with a radiation temperature of several keV. There is also a more intense radiation, apparently due to conversion of plasma waves excited by the beam at the plasma periphery. In the PETULA device, there is an important degradation of the plasma properties as the beam interacts with the composite limiter (alundum + carbon). Estimates of some of the beam properties and the radiation temperature are reported. These estimates agree in order of magnitude with the experimental data. The thermal emission of the plasma can be observed in the WEGA device when the electron acceleration is suppressed, by choosing the appropriate magnitude and direction for the original transverse magnetic field and by varying this field in the appropriate manner over the discharge. The average electron temperature is estimated to be 240 eV on the basis of the intensity of the second harmonic of the electron gyrofrequency under conditions corresponding to an "artificial" blackness of the radiating layer at a point 6 cm from the axis of the discharge chamber.

57982 Component intensities of the resonant doublet of hydrogen-like ions in an optically thin, laser-produced plasma. Boiki, V.A.; Vinogradov, A.V.; Pikuz, S.A.; Skobeler, I.Y.; Faenov, A.Y.; Yukov, E.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 54-58(Jan 1978).

The intensity ratio chi=I (2p/sub 1/2/—1s/sub 1/2/)/I (2p/sub 3/2/—1s/sub 1/2/) of the fine-structure components of the La resonant doublet of H-like ions has been studied experimentally for elements with atomic numbers Z=12—16 in an optically thin, laser-produced plasma. Comparison of the experimental results with numerical calculations of the function chi (N/sub e/) shows that resonant emission of hydrogen-like ions is excited in those parts of the plasma in which the electron density N/sub e/ is ~2 x 10^{21} cm^{-3}.

57983 Additional collisionless mechanism of HF energy dissipation in conditions of the plasma resonanse. Barinov, V.I. (AN SSSR, Moscow. Fizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 239-245(Mar-Apr 1977). (In Russian).

Experimental studies have been made of generation of accelerated electrons in plasma under the effect of weak external SHF fields (Vsub(E)/Vsub(Te) approximately 10^{-4} - 10^{-2}, where Vsub(E) is the vibrational velocity in a vacuum and Vsub(Te) is the thermal

velocity), but under initial conditions corresponding to the plasma resonance. The possible mechanism of acceleration, associated with breaning adiabaticity of the electron motion in a high-frequency field localized near a singular point, has been discussed.

57984 Investigation of the mechanism of effective collisionless ion beam-plasma interaction in a transverse magnetic field. Borisenko, A.G.; Kirichenko, G.S. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). *Fiz. Plazmy;* **3**: No. 2, 351-356(Mar-Apr 1977). (In Russian).

Excitation of longitudinal oscillations of the low-hybrid branch in a plasma by an ion beam injected across a magnetic field has been studied. The spectrum and increments of the excited oscillations and their effect of the beam velocity distribution function have been examined under the following conditions: plasma density from 10^9 to 10^{10} cm^{-3}, electron temperature about 10 eV, ion temperature about 1 eV, monoenergetic beam current from 1 to 2 mA, energy from 0 to 500 eV, magnetic field up to 300 Oe and flight length 10 cm. The optimum conditions instability development correspond to the plasma density and magnetic field with the ratio of cyclotron electron frequency to plasma electron one being ωsub(He)/ωsub(pe) < or approximately 1. In nonlinear regions the beam ion velocity spectrum becomes plateau-like, i.e. thermalization of the beam in the plasma is practically achieved. Such effects may occur in thermonuclear traps with external injection.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 57825

57985 Monte Carlo algorithm for calculating neutral gas transport in cylindrical plasmas. Hughes, M.H.; Post, D.E. (Princeton University Plasma Physics Laboratory, Princeton, New Jersey 08540). *J. Comput. Phys.;* **27**: No. 3, 43-55(Jul 1978).

Monte Carlo techniques have been used to calculate neutral gas distributions in tokamaks. The algorithm uses track length estimators, suppression of absorption, and splitting with Russian roulette to reduce the variance, so that the algorithm is economic. The resultant package is small in memory requirements and relatively fast (~15 seconds of PDP-10 KI time per neutral density profile). The tokamak is modeled as an infinite cylinder, and the plasma parameters are specified as a function of the radial coordinate of the cylinder. The effects of wall reflection and sputtering yields can be easily computed within the model. The algorithm has been incorporated in a one-dimensional tokamak transport code. The code has also been used to predict the energy spectra of charge-exchange neutrals which form the basis for measurements of ion temperatures in tokamaks.

57986 New expansion method for computing sigma-barv-bar for reactant distribution functions. Anon(NONE). (1 5255Dy). *J. Comput. Phys.;* **27**: No. 3, 115-121(Jul 1978).

A fast legendre expansion method is proposed for calculating the reaction rate parameter. (AIP)

57987 Electron-capture and impact-ionisation cross sections for partially stripped iron ions colliding with atomic and molecular hydrogen. Berkner, K.H.; Graham, W.G.; Pyle, R.V.; Schlachter, A.S.; Stearns, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Olson, R.E. *J. Phys., B (London);* **11**: No. 5, 875-885(14 Mar 1978).

Cross sections for single-electron capture and for impact ionisation by Fesup(q+) (q = 10, 15, 20, 25) ions incident on atomic hydrogen have been calculated in the energy range 50 to 1200 keV amu^{-1} using a classical-trajectory Monte-Carlo method. Cross sections for the same processes for Fesup(q+) ions incident on molecular hydrogen have been measured for q = 11-22 at 1100 keV amu^{-1}, for 1 = 9 at 277 keV amu^{-1}, and for q = 12 and 14 at 262 keV amu^{-1}. The experimental cross sections for molecular hydrogen divided by two are in excellent agreement with the calculated atomic hydrogen cross sections. Scaling laws for the cross sections with q, the charge state of the incident ion, are discussed. The scaling with q is not found to follow the q^2 law predicted by the binary-encounter theory.

57988 Effect of Lyman α self-absorption on population inversions between quantum states 2 and 3 of hydrogen-like ions in recombining plasmas. Tallents, G.J. (Australian National Univ., Canberra. Dept. of Engineering Physics). *J. Phys., B (London);* **11**: No. 5, L157-L161(14 Mar 1978).

The effect in recombining plasmas of Lyman α self-absorption on quasi-steady-state population inversions between quantum states n = 2 and 3 of hydrogen-like ions is theoretically investigated. It is shown how the electron density range over which population inversion is possible diminishes as Lyman α self-absorption increases. The highest degree of absorption which can be tolerated and still achieve an inversion is shown to occur when the thermal limit corresponds to n approximately equal to 4. The results of the computations are related to the conditions to be found in the expansion plume of laser-produced plasmas.

57989 Importance of metastable transitions to oxygen impurity radiation in tokamak plasmas. Rogerson, J.E.; Davis, J.; Jacobs, V.L. (Naval Research Lab., Washington, D.C. (USA)). *J. Quant. Spectrosc. Radiat. Transfer;* **19**: No. 2, 217-226(Feb 1978).

A non-hydrodynamic modified coronal model has been constructed for calculating line emission from several of the lower excited levels of the helium-like ionization stage of an oxygen impurity in a plasma discharge. Optical emissions were calculated as a function of time for these levels at several electron densities assuming a specified variation of electron temperature with time. It is found that the metastable $1s2p(^3P)$ level can contribute a significant fraction of the total impurity-line emission.

57990 Neutron yield from the plasma of a coaxial accelerator. Zolototrubov, I.M.; Krasnikov, A.A.; Kurishchenko, A.M.; Novikov, Y.M.; Poryatui, V.S.; Tolstolutskii, A.G. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 1-3(Jan 1978).

The neutron yield from a plasma produced in a coaxial accelerator in a homogeneous longitudinal magnetic field has been measured. The impositic :: of even a weak magnetic field (below 1 kOe) greatly reduces the neutron yield (by a factor of 4—5). The reason may be a decrease in the plasma density due to an increase in the cross-sectional area of the plasma.

57991 Spectrum of Cerenkov instabilities of a relativistic electron beam in a bounded anisotropic plasma. Aizatskii, N.I.; Kurilko, V.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 43-47(Jan 1978).

A theory is derived for the quasilinear stage of the Cerenkov amplification of quasilongitudinal waves in a plasma-filled waveguide by a relativistic electron beam. The spectrum of the energy flux density of the field and the corresponding of the system are found analytically and numerically as functions of the plasma density per unit length and the beam energy for the case of a magnetized plasma. The possibility of controlling the spectra of the corresponding amplifiers and oscillators is discussed.

57992 Population inversion of hydrogen levels in a supersonic hydrogen—argon plasma jet. Lukyanov, G.A.; Nazarov, V.V.; Pavlova, N.O. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 1, 26-28(Jan 1978).

The conditions for population inversion of hydrogen atomic levels with principal quantum numbers n = 4 and 5 are investigated in the free expansion region of a supersonic hydrogen—argon plasma jet. Data are obtained on the degree of population inversion as a function of the stagnation enthalpy and the amount of hydrogen in the mixture. The maximum inversion values obtained experimentally correspond to an enhancement coefficient of the order of 10^{-3} cm^{-1}. Analysis of the possible mechanisms for populating the atomic hydrogen levels under the experimental conditions indicates that population inversion of levels with n = 4 and 5 is evidently due to processes involving hydrogen molecules and molecular ions, not to collisional—radiative recombination and excitation transfer from argon atoms.

57993 Cross-field thermal losses near a wall-plasma interface. Jablon, C.; Longeon, R. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas). *Nucl. Fusion;* **18**: No. 6, 775-779(1978).

The physics of a wall-confined, fully ionized plasma is studied in the case where β much >1. When electron thermal diffusion is magnetically reduced, but still dominates over ion diffusion (1 approximately <ωsub(e)tausub(e) approximately <(msub(i)/msub(e))sup(1/4)), the Nernst effect is shown to increase the diffusion losses substantially. Simple criteria are derived to estimate the validity of the 'equipressure' condition. The results are checked by a one-dimensional hydro-code including the complete magnetic-field evolution. These results depend strongly on the wall boundary condition for the magnetic field.

57994 Loss of alpha particles during slowing-down in an axisymmetric tokamak reactor. Ohnishi, M.; Ao, N.; Wakabayashi, J. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). *Nucl. Fusion;* **18**: No. 6, 859-866(1978).

The containment properties of alpha particles during the slowing-down process in an axisymmetric tokamak reactor are studied by using Monte-Carlo calculations, in which the pitch-angle-scattering effects are included. The loss of alpha particles during slowing-down is found to be safely negligible in a pure DT plasma, but increases proportionally to the effective charge number of the plasma and cannot be ignored in a highly contaminated plasma (Zsub(eff)>4), compared with the loss of 3.5-MeV particles.

57995 Turbulence effect on Ohm's law in partially ionized plasmas. Numano, M. (Kyoto Univ. (Japan). Faculty of Engineering). *Plasma Phys.;* **19**: No. 12, 1197-1200(Dec 1977).

An investigation of the effect of nonuniformity on electric current flow in partially ionized plasmas is made. An Ohm's law for a nonuniform plasma was derived, from which Rosa's equation is obtained as a special case. Making use of this new Ohm's law, the effective electrical conductivity and Hall coefficient are determined for isotropically turbulent plasmas. They are found to be in good agreement with the results obtained previously.

57996 Electron density fluctuations in a plasma with collision frequency proportional to speed. Theimer, O.; Behl, Y.K. (New Mexico State Univ., Las Cruces (USA)). *Plasma Phys.;* **19**: No. 12, 1119-1128(Dec 1977).

The collective fluctuation spectrum of the electron density in a plasma is calculated by a new method which has been developed in an earlier paper (Theimer, Hicks and Behl, 1977). The method is applied to partially ionized plasmas with collision frequency vsub(e)(v) = av proportional to the speed of the electrons. The general formulas for the fluctuation spectrum are numerically evaluated and show that the sharp resonance peak near the electron plasma frequency is very sensitive to the speed dependence of vsub(e): the peak is only moderately broadened if the collision parameter ysub(e) is constant and of the order 0.1; however, it is practically washed out if ysub(e) is proportional to v while still being of the order 0.1 in the average. Conditions under which this effect may be observed are discussed.

57997 Steady-state toroidal plasma thermally self-sustained by thermonuclear fusion reaction. Mino, K. (Tokyo Inst. of Tech. (Japan)); Murakami, H. *J. Phys. Soc. Jpn.;* **43**: No. 2, 634-641(Aug 1977).

Without an assumption employed by Furth et al., numerical steady-state solutions of a D-T toroidal plasma are obtained in a self-consistent way from the momentum, energy and Maxwell equations for ions and electrons. The solutions satisfy the following requirements for the toroidal plasma in a power plant: 1) The ion temperature at the central part of plasma is high enough to feed a sufficient output power due to thermonuclear fusion reaction; 2) at the boundary, on the other hand, the ion temperature is so low as to keep the blanket out of thermal damages; 3) the safety factor with respect to screw instability is greater than 2 everywhere in the plasma.

57998 Collective modes of a two-dimensional electron fluid. Onuki, A. (Tokyo Univ. (Japan). Dept. of Physics). *J. Phys. Soc. Jpn.;* **43**: No. 2, 396-405(Aug 1977).

The dielectric function is calculated from the Vlasov-Boltzmann equation beyond the mean field approximation by considering the collisional effect among electrons. The collisional effect is large for any value of the plasma parameter in two dimensions. Hydrodynamic equations can be used for a fluid state in describing disturbances varying slowly in space and time because short-range correlations are large and collective modes are of low frequency in two dimensions. The dielectric function is calculated from linearized hydrodynamic equations including the presence of a magnetic field and dilute impurities. The expression is valid for small wavenumber and for a fluid state and coincides in the low density limit with that calculated from the Vlasov-Boltzmann equation. Collective modes are examined in various cases.

57999 Effects of nuclear fusion reaction on diffusion and thermal conduction in a magnetoplasma. Sakai, K. (Tokyo Univ. (Japan). Dept. of Physics); Aono, O. *J. Phys. Soc. Jpn.;* **43**: No. 1, 222-227(Jul 1977).

It is shown that vectorial phenomena couple thermodynamically with the scalar phenomena. This result is contrary to the well spread belief in the field of irreversible thermodynamics. Transport coefficients concerning the diffusion and the thermal conduction across a strong magnetic field are calculated in the presence of the deuteron-triton fusion reaction on the basis of the gas kinetic theory. When the reaction takes place, the diffusion coefficient increases and the thermal conductivity decreases. Effects of the reaction exceed those of the Coulomb collision as the temperature is high enough.

58000 Ion temperature scaling on JAERI tokamaks. Takeuchi, H.; Funahashi, A.; Takahashi, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Jpn. J. Appl. Phys.;* **16**: No. 7, 1227-1233(Jul 1977).

The dependence of the ion temperature on various parameters (line-averaged electron density anti n sub(e), plasma current I sub(p) and toroidal magnetic field B sub(t)) was investigated for the JAERI-tokamak devices JFT-2 and JFT-2a with 10-channel neutral particle energy analyzer. The measurements were performed by keeping two of the three parameters nearly constant, and they showed that the ion temperature obey the one-third power law in anti n sub(e), I sub(p) and B sub(t). The ranges of the parameters were $0.7 \times 10^{13} <= \text{anti n sub(e)} <= 1.8 \times 10^{13}$ cm^{-3}, 14 <= I sub(p) <= 170 kA and 10 <= B sub(t) <= 18 kG. The measured ion temperature ranged from 80 to 350 eV and was (1/2-1/4) of the central electron temperature. It followed the scaling law by Artsimovich T sub(i)=Km.(I sub(p)B sub(t) anti n sub(e)R^2)sup(1/3) with the numerical constant Km=(4.3-6.7) x 10^{-7} in eV.(A.G.cm^{-3}.cm^2)sup(-1/3).

58001 Kinetic equations and fluctuations in μspace of one-component dilute plasmas. Tokuyama, M.; Mori, H. (Kyushu Univ., Fukuoka (Japan). Dept. of Physics). *Prog. Theor. Phys. (Kyoto);* **58**: No. 1, 92-112(Jul 1977).

Kinetic equations for a spatially coarse-grained electron density in μ phase space A(p, r; t) with a length cutoff b and for its fluctuations are studied by a scaling method and a time-convolutionless approach developed by the present authors. An electron gas with a small plasma parameter epsilon=1/c (lambda sub(D))^3 has three characteristic lengths; the Landau cutoff r sub(L)=epsilon lambda sub(D), the Debye length lambda sub(D)=√k sub(B)T/$4\pi e^2$c and the mean free path l sub(f)=lambda sub(D)/epsilon, e and c being electronic charge and mean electron density, respectively. It is shown that there are two characteristic regions of the length cutoff b. One is a coherent region where r sub(L)<<b<<lambda sub(D). Its characteristic scaling is c→0, b→infinity, t→infinity with b√c and t√c being kept constant. The Vlasov equation is derived in this limit. The other is a kinetic region where lambda sub(D)<<b<<l sub(f). Its characteristic scaling is c→0, b→infinity, t→infinity with bc and tc being kept constant. The Vlasov term disappears and the Balescu-Lenard-Boltzmann-Landau equation, which is free of divergence for both close and distant collisions, is derived in this limit. It is shown that the fluctuations of A(p, r; t) obey a Markov process with scaling exponents α=0, β=1/2 in the coherent region near thermal equilibrium, while they obey a Gaussian Markov process with α=0, β=1 in the kinetic region. The present theory does not need the factorization ansatz and Bogoliubov's functional ansatz.

58002 Strong ingomogeneity expansion on the background of an unbounded weak-ionized plasma in a magnetic field. Rozhanskii, V.A.; Tsendin, L.D. (Leningradskij Politekhnicheskij Inst. (USSR)). *Fiz. Plazmy;* **3**: No. 2, 382-387(1977). (In Russian).

Diffusion of strong inhomogeneity deltasub(n) > nsub(o) has been studied against the background of an infinite weakly ionized plasma in a magnetic field. It is shown that the mechanism of shorting over the background plasma leading to diffusion of a density disturbance with unipolar electron and ion diffusion coefficients is effective in the case of very strong inhomogeneities as well. Only when highly depleted areas in which the density is much lower than nsub(o), appear in the background plasma, transition to ambipolar diffusion takes place. In this case scales of the inhomogeneity are determined by minimum value of diffusion coefficients in respective directions, whereas the plasma density in the maximum must by far exceed nsub(o).

58003 Equilibrium of axially symmetric toroidal plasma with a rectangular cross section. Shoji, T.; Okuda, T. (Nagoya Univ. (Japan). Faculty of Engineering). *Mem. Fac. Eng., Nagoya Univ.;* **27**: No. 1, 142-151(May 1975).

The equilibrium problem of toroidal plasma with distributed current in a fat torus with any small toroidicity and rectangular cross section is analyzed. The analytical solution is deduced by the use of Green's function and the constant-variable method and also the some numerical results are given.

PLASMA PRODUCTION

58004 Satellite lines of low-Z elements (Li, Be, B) observed in laser-produced plasmas. Kennedy, E.T.; Carroll, P.K. (University Coll., Dublin (Ireland). Dept. of Physics). *J. Phys., B (London);* **11**: No. 6, 965-974(28 Mar 1978).

Satellite lines (thirty-two in all) to the hydrogen- and helium like resonance series of the low-Z elements, Li, Be and B, have been observed in studies of the emission and absorption spectra of laser-produced plasmas. Hartree-Fock calculations were carried out for the transitions involved and the results were compared with the observations. The behaviour of satellites generally at low=Z values is surveyed.

58005 Laser-produced plasma in a strong magnetic field. Kaitmazov, S.D.; Shklovskii, E.I. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 48-54(Jan 1978).

Work on the interaction of laser-produced plasmas with magnetic fields, primarily in the range 100—300 kOe, is reviewed. About 15 papers are interpreted; a total of 41 are cited. These papers deal primarily with the effect of the field on the threshold for the optical breakdown of gases, the geometry (kinetics) of the laser- produced plasma, and the plasma emission. It follows from these papers that a magnetic field can reduce the threshold for optical breakdown in

gases, can contribute to plasma expansion primarily along the direction of the magnetic field, and can affect (in the visible range, increase) the intensity of the radiation from the laser-produced plasma. The effect of the field on the plasma temperature has not been studied adequately, and it is not possible to draw definite conclusions about this effect from the experimental results reported by the various investigators.

58006 Thermal microwave emission from the shock wave of a laser spark. Askar'yan, G.A.; Manzon, B.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 58-61(Jan 1978).

The thermal emission in the infrared range ($\lambda = 100\ \mu$) and in the millimeter range ($\lambda = 1$ mm) from the strong explosion of the optical spark at the focus of a laser beam is studied. During the first few microseconds, this emission is due to the compressional layer of a shock wave; later, it is due to emission of a fireball. The effective ratio of specific heats for the hot inner part of the fireball is determined from the time evolution of the emission.

58007 Observation of laser-driven compression of gas-filled microspheres. Basov, N.G.; Erokhin, A.A.; Zakharenkov, Y.A.; Zorev, N.N.; Kologrivov, A.A.; Krokhin, O.N.; Rupasov, A.A.; Sklizkov, G.V.; Shikanov, A.S. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 8, 433-436(20 Oct 1977).

Results are presented of experimental investigations of the interaction of radiation from the nine-channel "Kal'mar" installation with spherical SiO_2 shells filled with deutrium. Pinpoint cameras were used to record a thousand-fold compression of the target.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 58033, 58046

58008 (AD-A—049547) **Studies of parametric decay instabilities in magneto plasmas. Final scientific report, April 1974—June 1977.** Kuo, S.; Cheo, B.R. (Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Electrical Engineering and Electrophysics). Jun 1977. 94p. (POLY-EE/EP—77-207). NTIS PC A05/MF A01.

A theory is developed for the parametric excitation of coupled waves in a uniform magneto plasma. Instead of using electrostatic approximation which is valid only for longitudinal waves, a general formulation of the parametric coupling equations is developed by using Hamiltonian approach. The plasma is pumped by a monochromatic electromagnetic wave with frequency which decays into two decay waves (e.g., a plasmon and a phonon). Either one of the plasma modes coupled with the pump wave (through the linearized Vlasov equation) to induce a polarization which may act as the source of another mode. A general procedure to calculate the induced polarizations is introduced by transforming the linearized Vlasov equation into the oscillating frame of reference, in which the equation can then be solved by the method of characteristics. The threshold power, initial growth rate and the frequency shift (due to finite initial growth rate) of the parametric instabilities can be obtained from the coupled mode equations and the results obtained can be applied to all the wavelength region. Several interesting cases are presented and compared favorably with experiments. The simultaneous excitation of second harmonic of electron-cyclotron and electrostatic ion-cyclotron oscillations by means of a monochromatic electromagnetic wave at frequency = 9.23 GHz has been observed experimentaliy.

58009 (UCRL—81275) **New results in high beta MHD theory. Part III. MHD equilibrium and stability of minimum-B mirror traps.** Hall, L.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jun 1978. Contract W-7405-ENG-48. 5p. (CONF-780811—1). Dep. NTIS, PC A02/MF A01.

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

In a general high-beta guiding-center MHD equilibrium of an anisotropic minimum-B mirror-trapped plasma, stability is determined by the sign of the Kruskal-Oberman energy variation. The energy variation is given for near-marginally-stable line-localized perturbations, and within a positive factor. A brief theoretical discussion of various instabilities for different conditions is given. (MOW)

58010 Critical surface filamentation and the parametric instability. Begg, I.M.; Cairns, R.A. (Saint Andrews Univ. (UK)). *Phys. Lett., A;* **65**: No. 5, 411-412(3 Apr 1978).

The effect of critical surface filamentation upon laser absorption via the decay instability is examined.

58011 Transport of a relativistic electron beam to a fusion target. Rudakov, L.I. (I. V. Kurchatov Institute of Atomic Energy, Moscow). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 40-43(Jan 1978).

The large angular divergence of the electrons in a high-current beam imposes a fundamental limitation on the degree of radial compression of electron beams. If electromagnetic energy is transported from the storage bank to the fusion target along a vacuum transmission line with magnetic insulation, it may be possible to avoid this difficulty.

58012 Self-modulation of the cyclotron instability of Alfven waves. Bespalov, P.A.; Trakhtengerts, V.Y. (Scientific-Research Radiophysical Institute, Gor'kii). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No 1, 103-106(Jan 1978).

A drift mechanism for the excitation of Alfven waves in the magnetosphere is studied, with the cyclotron instability being taken ino account. The coupling of the Alfven waves with the cyclotron instability, the growth of Alfven waves is accompanied by the growth of relaxation oscillations of the cyclotron instability, which correspond to the appearance of an intensity modulation (at the Alfven frequency) of the cyclotron radiation and of the fluxes of fast electrons which are precipitated from the geomagnetic confinement system. This theory explains several related geophysical effects, including the pulsed spilling of particles, the quasiperiodic VLF radiation, and geomagnetic pulsations.

58013 Excitation of a trapped-ion mode in a tokamak with a group of fast particles. Mazur, V.A. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Siberian Branch, Academy of Sciences of the USSR, Irkutsk). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 111-113(Jan 1978).

The possible excitation of a trapped-ion mode is analyzed for a tokamak with fast neutral injection and, in a tokamak fusion reactor containing reaction products, α particles. The destabilizing effect of the fast ion beam results from a resonant interaction of the wave with trapped beam particles. At this resonance, the wave frequency in the coordinate system of the drifting banana is equal to a harmonic of the oscillation frequency of the trapped ion. The growth rate of the instabiliy is calculated. It is concluded that the trapped-ion mode is stable in a tokamak with injection, and it is concluded that this mode can be excited in a tokamak reactor if the relative concentration of α particles is higher than 10^{-3}.

58014 Effect of a beam on the stability of Alfven waves in a tokamak. Meitlis, V.P. (Institute of High Temperatures, Academy of Sciences of the USSR). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 113-115(Jan 1978).

The stability of Alfven waves in the presence of an ion beam is analyzed for the conditions typical of tokamaks. Shear has a stabilizing effect on the beam instability.

58015 Linear feedback control of plasma waves. Cherkashin, M.Y.; Chuyanov, V.A. (I. V. Kurchatov Institute of Atomic Energy, Moscow; Institute of Problems of Control). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 121-129(Jan 1978).

It is possible to construct a linear feedback system to control the plasma waves and to maintain a given distribution of the wave growth rates and frequencies. This possibility is demonstrated for the case of flute waves. Experimental results of the use of a feedback system in the Ogra 3 device are reported.

58016 Local MHD stability of equilibrium plasma configurations. Solov'ev, L.S. *Sov. Phys. - Tech. Phys. (Engl. Transl.);* **23**: No. 1, 12-13(Jan 1978).

A necessary condition for the stability of equilibrium plasma configurations is derived for an arbitrary geometry when the ratio of the acoustic velocity to the Alfven velocity is small, this condition reduces to the Mercier condition; in the limit of vanishing shear, it reduces to the Spies condition. For small shear the condition derived here relaxes the restrictions on the parameters of the equilibrium configuration as compared with the Mercier condition. An approximate form of the condition is derived for a toroidal configuration whose magnetic axis has small curvature.

58017 Measurements of particle and heat diffusion due to the collisionless drift instability. Boissier, R. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). *Nucl. Fusion;* **18**: No. 6, 867-871(1978).

The linear theory of drift waves in a collisionless plasma can give the radial particle and energy flux for a given level of fluctuations. In the ODE device, good agreement was found between direct transport measurements and linear-theory predictions. The experimental methods of diffusion measurement in the hydrogen plasma column are described.

58018 Non-local drift instability of current-carrying plasma with temperature inhomogeneities. Inoue, S.; Itoh, K. (Tokyo Univ. (Japan). Dept. of Physics); Yoshikawa, S. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nucl. Fusion;* **18**: No. 6, 755-759(1978).

The current-driven (CD) drift instability of a collisionless plasma with both electron and ion temperature inhomogeneities in a

sheared magnetic field is investigated. It is found that the CD mode can become unstable with the universal mode is stable, and that the positive ion temperature gradient affects the stability by suppression (or reduction) of convective damping through magnetic shear. The resulting particle and heat fluxes due to the CD mode are also obtained.

58019 Toroidal plasma produced by the stabilized double-theta pinch. Itoh, K.; Kondoh, Y. (Department of Electronic Engineering, Gunma Univ., Kiryu, Japan); Nagao, S. (Tohoku Univ., Sendai (Japan)). *Nucl. Fusion;* **18**: No. 6, 769-774(1978).

The properties of the toroidal plasma produced by the stabilized double-theta pinch are investigated experimentally and theoretically. The toroidal plasma produced has a strongly elongated cross-section with the half-axis ratio b/a approximately 14 and an aspect ratio R_0/a approximately 8 at $t=3\mu s$, when the values of β and βsub(p) are approximately 0.23 and 0.30, respectively. It is shown that in the vicinity of the median plane of the plasma the Suydam criterion $S>=0$ for the high m-mode is satisfied throughout the cross-section of the plasma produced. With the one-dimensional approximation, an analytic solution of MHD equilibrium is presented which always satisfies the Suydam criterion.

58020 Observations of large-amplitude helical kink instabilities and field reversal in a fast pinch experiment (HBTX-1). Verhage, A.J.L.; Robinson, D.C. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.); Furzer, A.S. (Royal Holloway College, Egham, Surrey, United Kingdom). *Nucl. Fusion;* **18**: No. 4, 457-473(1978).

Amplification of toroidal flux in compressed stabilized z-pinches in HBTX-1 (R=100cm, a=6cm) has been observed during MHD instabilities. The increase in flux leading to reversal of longitudinal magnetic field in the outside region when the toroidal flux is conserved is attributed to the large-amplitude stage of an m=1 helical kink instability which redistributes the magnetic field. The measured values of wavelength, amplitude and growth rate in the early stages of the m=1 instability observed during self-reversal are predicted with linear MHD stability computations which include dissipative effects. The observed radial expansion of the plasma is interpreted as a non-linear effect associated with the large-amplitude stage of the instability. After the process of self-reversal an approximately constant value of the pinch ratio (defined as the ratio of the average value of Bsub(theta) at the wall to Bsub(z), averaged over the plasma) is obtained, which is independent of the initial parameters of the pinch.

58021 Effect of external plasma on the decay of a neutral current sheet. Bulakov, S.V.; Sasorov, N.V.; Syrovatskii, S.I. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 11, 565-568(5 Dec 1977).

Decay of a current sheet (CS) leads to production of reclosing magnetic-field regions that travel along the sheet with super-Alfven velocity. Their dimension is determined by the electric conductivity in the plasma outside the CS.

58022 Observation of parametric decay instability near the lower hybrid resonance. Bonizzoni, G.; Fontanesi, M.; Grosso, G.; Lazzaro, E.; Sindoni, E. (Consiglio Nazionale delle Ricerche, Milan (Italy). Lab. di Fisica del Plasma e di Elettronica Quantistica). *Plasma Phys.;* **19**: No. 12, 1163-1175(Dec 1977).

Resonant and non-resonant parametric decay instabilities in the region near the lower hybrid resonance have been investigated in a mirror linear device. The identification of the two processes was possible by comparing with theory the experimental value of the ratio w_0/wsub(LH) between the pump frequency and the maximum lower hybrid frequency. In connection with the appearance of decay into quasi-modes, electron and ion heating was found. The propagation of the pump and of the decay waves has been also studied. A pattern of trajectories following a 'resonant cone' was found both for the pump and the decay waves. The measured values of the resonant angles show a reasonable agreement with the theory.

58023 Micro-instabilities due to fast ions in a high pressure plasma in a curved magnetic field. Meerson, B.I. (AN SSSR, Moscow. Inst. Prikladnoj Geofiziki); Mikhailovskii, A.B.; Pokhotelov, O.A. *Plasma Phys.;* **19**: No. 12, 1177-1185(Dec 1977).

Micro-instabilities due to resonant interaction between waves and fast ions in an inhomogeneous high pressure plasma in a magnetic field with constant curvature are investigated. The influence of the magnetic field curvature and the fast-ion pressure on the resonance conditions and growth rate of the Alfven-type wavelength drift oscillations are studied for a broad range of parameters. The general expressions obtained are used to investigate the excitation of Alfven waves by fast ions with (a) Maxwellian and (b) 'loss cone' velocity distributions.

58024 Ion-acoustic instability in the presence of high frequency oscillations. Rasmussen, J.J.; Sandu, D.; Schrittwieser, R. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). *Plasma Phys.;* **19**: No. 12, 1139-1144(Dec 1977).

Measurements are presented of a standing ion-acoustic wave instability, which is excited by a positively biased grid inserted perpendicularly into the plasma column of a single-ended Q-machine, under the influence of a high frequency signal superimposed onto the positive voltage at the grid. The experimental results show that in certain regions of the frequency and amplitude of the h.f. signal the ion wave instability is stabilized or destabilized. A possible explanation of these effects is presented.

58025 Problem of a decay instability of electromagnetic waves in a magnetoactive plasma. Roslyakov, V.A.; Starostin, A.N. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). *Zh. Eksp. Teor. Fiz.;* **73**: No. 5, 1747-1756(Nov 1977). (In Russian).

Processes of decay of transverse electromagnetic waves propagating across a stationary magnetic field are considered. The possibility is discussed of using the decays for tuning the stimulated emission frequency in a semiconductor magnetoactive plasma and also for diagnostics of magnetic fields spontaneously developing in a laser plasma.

58026 MHD instability of plasma column with an embedded ion beam. Ikuta, K.; Yamanaka, K (Nagoya Univ. (Japan). Inst. of Plasma Physics). *J. Phys. Soc. Jpn.;* **43**: No. 1, 301-304(Jul 1977).

It is theoretically predicted that an MHD instability is induced by an energetic ion beam which is rotating azimuthally about the axis of a magnetized plasma column. The beam-plasma system becomes unstable if the density of the embedded ion beam exceeds a critical value.

58027 Loss-cone instabilities suppresion in magnetic mirrow trap with a profiled magnetic field. Arsenin, V.V.; Pastukhov, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 306-310(Mar-Apr 1977). (In Russian).

It is shown that in a mirror trap, which has a slightly weakened magnetic field plugs, there is an extra region of confinement for low energy ions. Presence of a small quantity of such ions is known to supress loss-cone instabilities. Owing to low energy ion confinement in the trap, their concentration can be maintained at the level which is necessary for the stabilization at comparatively low energy consumption.

58028 Thermonuclear alfven instabilities in a tokamak reactor. Belikov, V.S.; Kolesnichenko, Ya.I.; Mikhailovskii, A.B.; Yavorskii, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 263-269(Mar-Apr 1977). (In Russian).

A study has been made into Alfven thermonuclear instabilities of a tokamak reactor, related to disturbances whose longitudinal wavelength lambda $= 2\pi/k$ is less or order of the length of the magnetic line of force on the torus circumference $2\pi qR$, i.e., $kqR >$ or approximately 1 (k is the longitudinal wave number, R is the radius of the torus magnetic axis, and q is the tokamak stability factor). Corresponding to such disturbances are, for example, the instability of flight alpna particles on cyclotron resonance and that of trapped alpha particles at low-frequency bounce-resonances. Also studied is the effect of the toroidal shape on the former instability, and it is shown that the right magnetic field approximation can be used for this study. The problem of thresholds of instabilities due to the damping of Alfven waves on trapped electrons is discussed.

58029 Stability of an elliptic plasma cylinder with a current in an arbitrarily shaped chamber. Danilov, A.F.; Popov, A.M. (Moskovskij Gosudarstvennyj Univ. (USSR)). *Fiz. Plazmy;* **3**: No. 2, 291-297(Mar-Apr 1977). (In Russian).

The stability of an elliptical plasma filament with a uniform current is studied on the basis of a numerical solution of ideal two-dimensional MHD equations for an incompressible liquid. The plasma is surrounded by ideally conducting walls of an arbitrary profile. Production of an plasma equilibrium configuration with elongated section of the filament is possible by using external stationary current conductors. In this case there is a separatrix of magnetic surfaces around the plasma. The effect of the separatrix on the stability of displacement of the filament as a whole in the direction of the major semiaxis is examined. Also examined is the possibility of producing such an equilibrium configuration which would be stable on the condition that the separatrix is entirely within the walls. Dispersion equation for axisymmetric oscillations is derived which proves that only those configurations are stable which the stationary point of the separatrix is beyond the walls. By surrounding the plasma by elliptical or rectangular walls one can achive stability, with the separatrix being within the walls, by narrowing the width of a vacuum layer between filament and walls.

58030 Plasma flute oscillation stabilization by means of a feedback system. Gribkov, V.M. (Moskovskij Gosudarstvennyj Univ. (USSR)). *Fiz. Plazmy;* **3**: No. 2, 298-305(Mar-Apr 1977). (In Russian).

Considered in this paper is the possibility of stabilizing flute oscillations of plasma in right traps with the aid of a feedback system involving measurement of the radial component of a disturbed electric field. It is assumed that the plasma is confined along the Z axis, while transducers and suppressing electrodes may be arranged at different distances from the axis of the system. For the flute oscillation equation in which the finite length of the plasma along the magnetic field is taken into account, an eigenvalue problem is examined with boundary conditions simulating the feedback system. It is assumed that the transfer factor is independent of frequency and that the azimuthal modes are separated. Numerical methods are used to study effects of the longitudinal dimensions of plasma, magnetic field gradient and vacuum region size on stability. Oscillation stability boundaries have been derived, depending on the feedback factor values and the transducer location.

58031 Parametric decay in an inhomogeneous plasma. Silin, V.P.; Starodub, A.N. (AN SSSR, Moscow. Fizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 280-290(1977). (In Russian).

It is shown, with parametric transformation of a pumping wave to a Langmuir and ion-sound waves serving as an example, that an absolute instability due to the spatial structure of the pumping wave may develop in an inhomogeneous plasma. In the case of such an instability disturbances whose amplitudes increase with time are localized near extrema of the pumping wave field. It is also shown that disturbances of two types occur in plasma, whose excitation thresholds have been determined. Under conditions of interest for achieving a controlled thermonuclear reaction by laser radiation of solid targets the instability threshold is determined substantially by a plasma inhomogeneity and surpasses by far the threshold in a homogeneous plasma. The effect of absorption of the pumping wave on parametric decay has been examined.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 57970, 58012

58032 (PPPL—1455) **Complex Modified Korteweg—DeVries equation, a non-integrable evolution equation.** Karney, C.F.F.; Sen, A.; Chu, F.Y.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1978. Contract EY-76-C-02-3073. 12p. (CONF-780685—2). Dep. NTIS, PC A02/MF A01.

From Symposium on nonlinear structure and dynamics in condensed matter; Oxford, UK (27 Jun 1978).

The two-dimensional steady-state propagation of electrostatic waves is governed by delta v/delta tau + delta^{3}v/delta xi^3 + delta[(absolute value of v)^{2}v]/delta xi = 0, the Complex Modified Korteweg-DeVries equation. The properties of this equation are studied.

58033 Nonlinear behaviour of a finite amplitude electron plasma wave. 3. The sideband instability. Franklin, R.N. (UKAEA, Abingdon. Culham Lab.); MacKinlay, R.R.; Edgley, P.D.; Wall, D.N. *Proc. R. Soc. (London), Ser. A;* **360**: No. 1701, 229-242(21 Mar 1978).

Computations of the evolution of the electron distribution function in a plasma subsequent to the excitation of a constant finite amplitude electron plasma wave show that the system is stable for plasma parameters for which under experimental conditions the sideband instability is found to be excited. When the time (or space) variation of wave amplitude is concluded a group of particles initially trapped is detrapped and then behaves like an electron beam passing through the plasma. The experimental dispersion of test waves in a low density plasma is compared with theoretical predictions for parameters given by the detrapping model. Further, measurements of the electron distribution function in the presence of a finite amplitude wave as a function of position, wave amplitude, and wave frequency, show features which are consistent only with a detrapped beam.

58034 Dispersion equation and integrals of motion for transverse waves in a plasma. Davydovskii, V.Y. (V. D. Kalmykov Taganrog Radiotechnical Institute). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 107-110(Jan 1978).

The dispersion equation is derived from the three scalar integrals of motion of a charged particle in a monochromatic, transverse plane wave for the case of circular polarization. When the density of the medium is unperturbed, this dispersion relation is valid for a collisionless relativistic plasma, for arbitrarily strong waves. Familiar results are found from this relation in particular cases. This dispersion relation can be used to study several nonlinear effects.

58035 Nonlinear stage of the interaction of a charged-particle beam with a plasma in a magnetic field. Aburdzhaniya, K.D.; Kitsenko, A.B.; Pankratov, I.M. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Institute of Applied Mathematics, Academy of Sciences of the USSR, and Tbilisi State University). *Sov. J. Plasma Phys. (Engl. Transl.);* **4**: No. 1, 130-134(Jan 1978).

The amplification by a monoenergetic beam of charged particles of plasma waves propagating nearly across an external magnetic field is analyzed. The equations of the single-mode approximation are integrated numerically on a computer. The energy transferred to the plasma waves can be comparable to the initial kinetic energy of the transverse motion of the beam particles.

58036 Short-range laser beam self-focusing in a plasma due to relativistic effects on the refractive index. Kane, E.L.; Hora, H. (Department of Theoretical Physics, University of New South Wales, Kensington, N.S.W., Australia). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 1, 7-11(Jan 1978).

The existing theory of relativistic self-focusing is extended to electron densities n/sub e/ close to and above the cutoff density n/sub e/c. It is shown that relativistic self-focusing is possible at densities n/sub e/$<$ or $=$n/sub e/c for laser intensities of the order of 10^{-3} times the relativistic intensity of 3.66×10^{18} W/cm^2 for an Nd glass laser. Additionally, very-short-range self-focusing is predicted over distances of the order of the initial beam diameter. The lowest threshold intensity is calculated and its dependences on the plasma temperature and ionization number are found. The increase in the effective collision frequencies due to instabilities is evaluated.

58037 Contribution to the theory of magnetosonic turbulence. Sagdeev, R.Z.; Stonikov, V.I.; Shapiro, V.D.; Shevchenko, V.I. (Institute of Space Research, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **26**: No. 11, 582-586(5 Dec 1977).

Strong turbulence of magnetosonic waves and the associated collisionless energy-dissipation mechanism are investigated.

58038 Coupling coefficients for a cold plasma in a circularly polarized wave. Stenflo, L. (California Univ., Berkeley (USA). Dept. of Physics). *Plasma Phys.;* **19**: No. 12, 1187-1195(Dec 1977).

A cold unmagnetized plasma, which is penetrated by a circularly polarized pump wave with very large amplitude is considered. It is shown that the wave coupling coefficients as well as the dispersion relation can be significantly changed by the pump wave.

58039 Wave propagation to lower hybrid resonance in a magnetic field with shear. Ohkubo, K.; Ohasa, K.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). *J. Phys. Soc. Jpn.;* **43**: No. 2, 642-647(Aug 1977).

The ray trajectories of electrostatic wave to the lower hybrid (LH) resonance on the meridian plane of torus is significantly modified as compared with that without shear. The ray starting from the vicinity of the plasma surface rotates spirally around the magnetic axis. The ray reaching the layer S=0, where the perpendicular dielectric constant vanishes, is not terminated but reflected along the second characteristic curve towards another point on the layer S=0. After being reflected successively, rays finally converge on the node point of the layer S=0 on the equatorial plane. In the absence of the layer S=0 the rays infinitely reflect between the cutoff layers near the center and surface of plasma and cover all the region between the layers.

58040 Modulational instability of electron plasma and ion plasma waves. Ogino, T.; Makino, M.; Takeda, S. (Nagoya Univ. (Japan). Faculty of Engineering). *J. Phys. Soc. Jpn.;* **43**: No. 1, 295-300(Jul 1977).

Through application of the reductive perturbation method to the fluid equations for electrons and ions, a nonlinear Schroedinger equation is derived. For the electron plasma wave, the assumption of the uniform background of ions is not used. Then exact properties of the equation are obtained for all wave numbers, including a modulationally unstable region predicted by Zakharov. For the ion-acoustic mode, the assumptions of the Boltzmann distribution for electrons and of cold ions are not used. Then a modulationally unstable region for the ion plasma wave exists for wavelengths shorter than the electron Debye length, and the growth rate of the instability is appreciably large even at low ion temperatures.

58041 Observation of nonlinear Landau damping of electrostatic waves in an electron beam-plasma system, 2. Sugaya, R.; Sugawa, M.; Nomoto, H. (Ehime Univ., Matsuyama (Japan). Faculty of Science). *J. Phys. Soc. Jpn.;* **43**: No. 1, 305-309(Jul 1977).

The nonlinear Landau damping and growth of electrostatic waves in an electron beam-plasma system in a magnetic field have been observed. The space charge wave of the beam decays nonlinearly into the unstable Trivelpiece-Gould mode excited linearly by the cyclotron coupling with the beam. The resonant condition ω_0-ω_1-(kappa sub(parallel 0)-kappa sub(parallel 1))v sub(b)=ωsub(c) (m is an integer) is satisfied, and this nonresonant decay is due to the nonlinear interaction of two waves with the beam. The decay wave can be amplified exponentially by increasing the amplitude of the

pump wave. The nonlinear Landau damping coupling coefficient measured experimentally is compared with theory.

58042 Fluctuations of plasmons localized in a plasma by an electromagnetic pump wave. Silin, V.P.; Starodub, A.N.; Filippov, M.V. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 1, 97-102(Jul 1977).

It is shown that spatially localized plasma waves that do not increase with time are produced in a spatially inhomogeneous plasma in the vicinity of the region where a pump wave decays into two plasmons. A theory of the stationary fluctuations of these spatially localized waves is formulated. The fluctuations are shown to undergo a critical growth when the instability threshold is approached. A collision integral that takes into account the influence of the localized plasma waves is obtained.

58043 Small-scale structure formation and electromagnetic waves resonance absorption in a magneto-active plasma. Ehidman, V.Ya. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Radiofizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 2, 338-345(Mar-Apr 1977). (In Russian).

The paper is concerned with formation of a small-scale structure near the plasma resonance caused by an electromagnetic field penetrating into plasma. It is assumed that the electron density depends only on the square of electric field amplitude $(E)^2$. Also considered are condition when the field in the plasma is similar in structure to the field of an ordinary wave and in a linear approximation there is no interaction with an E-wave which in this case is in the resonance. It is shown, assuming that the external magnetic field is relatively small, that the small-scale structure is formed at $(E)^2 >$ > Esub(cr)^2 (Esub(cr)^2 approximately νsub(e)/ω)). The electromagnetic field energy dissipation occurring therewith is of a universal nature and does not depend either on the value of νsub(e)/ω or on the particular type of the nonlinearity under consideration.

58044 Second helicotron branch in plasma due to the relativistic motion of electrons and existance of the wave amplitude finiteness. Kotsarenko, N.Ya. *Fiz. Plazmy;* **3**: No. 2, 349-350(Mar-Apr 1977). (In Rusisan).

A second helicon branch is shown to exist in a cold electron plasma. The branch is due to the relativistic nature of electron motion and the finiteness of the wave amplitude. An equation for the second helicon wave is solved on the basis of the system of the Maxwell equations and the relativistic hydrodynamic equation of motion for plasma electrons, with ions being assumed immovable. The frequency and phase velocity proportional to the square root of the wave amplitude have been found. The phase velocity of the second helicon wave is $\sqrt{}$ Hsub(o)/E times lower than the velocity of the first helicon wave at the same frequency (Hsub(o) is the external magnetic field and E - the wave amplitude.

58045 Potential drift wave self-focusing. Petviashvili, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 2, 270-272(Mar-Apr 1977). (In Russian).

It is known that under the effect of a hydrodynamic nonlinearity the effective wave number of the drift wave packet increases until a one-dimensional soliton is formed, running in the direction of ion drift velocity. It is shown that such a one-dimensional soliton is instable, which may result in two-dimensional circular solitons inclined at a small angle to a magnetic field and having a radius of about rsub(n)/A, where rsub(n) is the Larmor radius of ions and A^2 is the soliton dimensionless amplitude. It has been established that at a sufficiently small radius a two-dimensional soliton is insensitive to the magnetic field shear, which is indicative of the possibility of drift wave development in plasma as two-dimensional solitons up to critical levels from the point of view of plasma confinement.

58046 Langmuir waves modulation instability in plasma due to the electron-mass oscillation. Tsivtsivadze, T.A.; Tsintsadze, N.L. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). *Fiz. Plazmy;* **3**: No. 2, 277-279(1977). (In Russian).

The nonlinearity of parametric resonance in plasma, due to electron mass oscillation, is considered in the paper. It is shown that, in the case of a weak relativity, an exponential rise in the natural oscillation amplitude takes place, while in an increase in the external electromagnetic field amplitude, time modulation of natural waves is observed.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 57107

58047 (CONF-7706130—, pp 23p, Session 4, Paper 2) **Changing prospects for development of magnetic fusion energy.** Kintner, E.E. (Energy Research and Development Administration, Washington, DC). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

A brief review of the magnetic fusion energy program is given. The problems in funding of the research program are described. (MOW)

58048 (CONF-7706130—, pp 24p, Session 4, Paper 4) **Engineering limitations of proposed fusion power plants.** Parkins, W.E. 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The importance of reducing the construction cost of proposed fusion plants through reductions in reactor size for a given power output was discussed. It was pointed out that there is a minimum size limitation set by the requirement to remove the heat produced, and that this would result in a minimum volume of expensive materials of construction. (MOW)

58049 (CONF-7706130—, pp 21p, Session 4, Paper 5) **Fusion development programs outside the U.S.** Pease, R.S. (Culham Lab., Abingdon, Eng.). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

A review of the worldwide fusion program is given. Tokamak, pinch, and stellarator reactor systems are briefly discussed. (MOW)

58050 (CONF-7706130—, pp 24p, Session 5, Paper 3) **Magnetic fusion central power station design.** Burnett, S.C. (General Atomic Co., San Diego, CA). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

This presentation reviews some of the progress towards realizing the scientific feasibility of fusion by magnetic confinement, examines several concepts and designs for central power stations, and discusses the issues surrounding these designs that will determine the directions of fusion research and development efforts in the future. (MOW)

58051 (COO—2456-55) **Columbia Torus II: a high-beta tokamak.** Gross, R.A.; Weber, P.G.; Marshall, T.C. (Columbia Univ., New York (USA). Plasma Physics Lab.). May 1978. Contract ET-76-S-02-2546. 19p. (CONF-780585—1). Dep. NTIS, PC A02/MF A01.

From IEEE workshop on small toroidal plasma devices; Monterey, CA, USA (18 May 1978).

Torus II is a versatile, small rectangular cross section, high-beta tokamak. The operational principles of Torus II are described along with some design features. (MOW)

58052 (UWFDM—249) **NUWMAK: an attractive medium field, medium size, conceptual tokamak reactor.** Conn, R.W.; Kulcinski, G.L.; Maynard, C.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). May 1978. Contract EY-76-S-02-2272. 13p. (CONF-780508—54). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A new conceptual design of a medium field tokamak reactor shows that such systems can have high power density, a high degree of modularity, and moderate size. The design, called NUWMAK, is especially attractive from the viewpoints of system accessibility, low levels of long term radioactivity, and minimum penetrations. The power density (10 MW/m^3) and electrical power output (660 MW) are chosen as typical of a full scale reactor operating in a base-loaded mode. The plasma has a noncircular D shape and a toroidal β of 6%. Plasma heating is by RF at omega = 2 omega/sub CD/ (92 MHz) based on the fast magnetosonic mode. The TF coil set is unique in that just 8 superconducting coils are used. A set of 16 small water cooled copper trim coils that do not encircle the vacuum chamber correct the field ripple to below 2%. The blanket is constructed of the titanium alloy, Ti-6A1-4V, and is designed to minimize thermal cycling, to provide internal energy storage, and to eliminate the need for an intermediate heat exchanger. A lithium-lead eutectic, $Li_{82}Pb_{18}$, with a melting point of 464^{0}C is used as the tritium breeding and thermal energy storage material.

58053 High current density approach for a fusion device. Brunelli, B. (Associazione Euratom-CNEN sulla Fusione, Centro di Frascati, Rome (Italy)). *Nucl. Eng. Int.;* **23**: No. 268, 61-64(Mar 1978).

A line of experimental devices is described which has the goal of reaching deuterium-tritium thermonuclear ignition conditions by exploiting the properties of magnetically confined plasmas with relatively high particle and current densities. The line includes the Alcator series at MIT and the Frascati Torus in Italy.

58054 Tormac reactor considerations. Brown, I.G.; Kunkel, W.B.; Levine, M.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Fusion;* **18**: No. 6, 761-768(1978).

A magnetic confinement system in the form of a stuffed toroidal line-cusp (Tormac) is proposed as the basis for a thermonuclear reactor. The interior (stuffing) region is assumed to consist of closed magnetic flux surfaces and a Maxwellian DT plasma at high levels of beta. The particles in the surrounding sheath, on the other hand, are mirror-confined on open field lines and thus are lost into a divertor region at the ion-ion collision rate. The confinement based on this assumption is given by ntauαrsub(p)BTsub(i), where rsub(p) denotes the plasma minor radius. In this paper, power gain and net output of Tormac reactors for a wide range of parameters are calculated. The net power gain Qsub(E), the gross electric output power/circulating electric power, is found to have values between 2 and 10 for reasonable reactor dimensions and very modest magnetic field strengths. For example, a plant yielding 500MW net electrical power using ions at 40keV thermal energy and a magnetic field of 40kG would require a plasma of minor radius rsub(p)=1m and a major radius of 3m. Q enhancement by direct recovery of particle energy has not yet been included.

58055 Kakuyugo kenkyu kaihatsu no genjo. (Present status of nuclear fusion research and development in JAERI). Tokyo, Japan; Japan Atomic Energy Research Inst. (1977). 104p. (In Japanese).

As Japan's center in nuclear fusion research, JAERI had finished the first phase of research. In the second phase from fiscal 1975, emphasis is placed on and efforts are directed to completion of Tokamak critical plasma test device JT-60. Research works in JAERI are described in the following: torus plasma confinement, reactor core engineering and technology, large Tokamak devices development, and reactor engineering and technology.

58056 Prospects for utility applications of fusion power. Gouch, W.C. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 664-675(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

This paper examines the prospects for utility application of fusion power. Several points are emphasized, including progress to date, the critical phase that the R and D effort is entering, the urgent need for the utility industry to ensure that a useful product will evolve, the multiple uses of this primary energy source, and its role in the energy supply of the future. (MOW)

BLANKET ENGINEERING

58057 (BNL-NCS—50681, pp 59-76) **Review of magnetic fusion energy neutron cross section needs: neutronics viewpoint.** Dudziak, D.J.; Muir, D.W. (Los Alamos Scientific Lab., NM). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

In the overall context of fusion nucleonic analysis, most cross section deficiencies lie in the energy range 14 MeV and below. This review deals not only with new data requirements generated by current interest in d-Li sources but also with the needs of conventional nucleonic studies (i.e., 14-MeV source calculations). The many compilations of requirements are referenced, and the current assessment of high-priority needs is succinctly summarized. Then typical methodology and results (sensitivity and uncertainty analysis) are given for quantitative data assessments of the Tokamak Fusion Test Reactor and a fusion Experimental Power Reactor. Finally, a summary is presented of some probings into data above 14 MeV, which have potential applications for d-Li irradiation facilities, d-Be medical therapy sources, and electronuclear fuel production facilities. 2 figures, 9 tables. (RWR)

58058 (BNL-NCS—50681, pp 375-389) **Integral experiments for CTR nuclear data.** Maynard, C.W. (Univ. of Wisconsin, Madison). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The key results of the combined theory of data adjustment and integral experiments are reviewed and discussed from the point of view of their relevance to CTR work. Integral experiments available to data are then reviewed. 3 tables. (RWR)

58059 (UWFDM—246) **BWTR (Boiling Water Tokamak Reactor) blanket study.** Sze, D.K.; Maynard, C.W.; Sviatoslavsky, I.N.; Cheng, E.T.; Wang, C.C.; Wrazel, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). May 1978. Contract EY-76-S-02-2272. 11p. (CONF-780508—57). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

The NUWMAK design is a second generation reactor design study. It utilizes the experiences we obtained from UWMAK series designs, combined with recent development in plasma physics and aimed toward a more optimized reactor design. The blanket for NUWMAK is designed to minimize thermal cycling, provide internal thermal energy storage, eliminate the need for an intermediate loop, minimize tritium inventory, facilitate tritium recovery, reduce the possibility of violent chemical reaction, and minimize long term radioactivity. These requirements are satisfied in the NUWMAK blanket design.

58060 Experiments with a limiter of variable radius in the TFR tokamak. *Nucl. Fusion;* **18**: No. 6, 791-806(1978).

The characteristics of TFR plasmas have been investigated for limiter radii from a=12.5 to a=19cm and for two limiter materials, molybdenum and graphite. The central electron temperature is roughly proportional to a. The energy confinement time scales approximately as a^2. It is not clear whether this is true geometrical scaling or the consequence of a particular behaviour of the radiation losses. The concentration of light impurities decreases with increasing plasma-to-wall distance. The same is true for heavy elements (molybdenum) layered on the wall when a light element (graphite) is used as the limiter material.

58061 Particle and energy fluxes observed in the scrape-off layer of JFT-2 tokamak. Gomay, Y. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan). Research and Development Center); Fujisawa, N.; Maeno, M.; Suzuki, N.; Yamamoto, T.; Konoshima, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Uehara, K. (University of Tsukuba, Japan). *Nucl. Fusion;* **18**: No. 6, 849-857(1978).

Particle and energy fluxes in the scrape-off layer produced by poloidal limiters are studied in the JFT-2 tokamak with mean electron densities of 1.3×10^{13} and 2.8×10^{13} cm^{-3}. The measurements were made by a combined Langmuir/thermoprobe and an infrared camera. The electron density in the scrape-off layer decays exponentially with increasing minor radius, implying that the cross-field diffusion is of the order of the Bohm diffusion. It is shown that heat transmission to the limiter more than 1cm behind the edge radius is determined by a sheath of Maxwellian particles. Near the edge radius, accelerated electrons play a major role, which is indicated by toroidal anisotropy of the heat flux in the lower-density case.

58062 Blister divertor for tokamaks. Gralnick, S.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nucl. Fusion;* **18**: No. 6, 876-880(1978).

A new divertor concept is proposed that introduces minimal added complexity (and hence cost) to the design of a tokamak. This concept is based on the creation of a localized region of enhanced toroidal field ripple by increasing the bore size of one or more of the toroidal field coils. Plasma particles that are trapped in the enhanced-ripple region, which we call a blister, experience strong drift motions which provide a means for collecting these particles. The results of model calculations that demonstrate the feasibility of producing the required blister region and a preliminary evaluation of the divertor collection efficiency are presented.

58063 Reduced fusion-neutron production in non-axisymmetric tokamak devices. Jassby, D.L.; Towner, H.H.; Goldston, R.J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nucl. Fusion;* **18**: No. 6, 825-833(1978).

In tokamak plasmas subjected to substantial toroidal-field ripple, sufficiently energetic members of the bulk-ion population can diffuse rapidly away from the hot central region by the superbanana process. The ion velocity distribution is truncated at the velocity above which the escaping fast ions cannot be replaced sufficiently rapidly by Coulomb collisions. This tail-depletion effect causes a marked reduction in the fusion reactivity and can give rise to an anomalously low central ion temperature as deduced from the thermonuclear neutron flux. The application of this phenomenon to the Alcator and TFR plasmas is discussed.

58064 Ion sputtering, evaporation and arcing in DIVA. Ohasa, K.; Maeda, H.; Yamamoto, S.; Nagami, M.; Ohtsuka, H.; Kasai, S.; Odajima, K.; Kimura, H.; Sengoku, S.; Shimomura, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Nucl. Fusion;* **18**: No. 6, 872-875(1978).

Experimental studies on the origin of metal impurities in DIVA are described. Three processes of metal impurity release, i.e. ion sputtering, evaporation and arcing, have been identified. Among these processes, ion sputtering is the dominant process in the quiet phase of the discharge, which is characterized by the lack of spikes in the loop voltage as well as by the fact that no heat flux concentration towards a specific part of the first wall takes place. Moreover, it is demonstrated that a honeycomb structure can decrease the metal impurity release.

58065 Development of movable limiters for JT-60. Imaizumi, T.; Maeda, H.; Minakuchi, T.; Mori, H.; Okamura, H. (Sumitomo Ship-

building and Machinery Co. Ltd., Tokyo (Japan)). *Sumitomo Jukikai Giho;* **25**: No. 74, 8-15(Aug 1977). (In Japanese).

Japan Atomic Energy Research Institute (JAERI) is planning to make the control devices known as movable limiter for JT-60 (JAERI's Large Tokamak) to suppress skin effect of a plasma current. One pair of limiter bars placed in a large vacuum vessel are required to pull up at a high speed synchronizing with plasma expansion. The actuator system and vacuum seal method have newly been developed. Servo hydraulic system characterized by meter-out flow control is used as drive system and welded bellows with protection mechanism from shock-like operation are used for vacuum seal. In a vacuum vessel, dry bearing is used. Experimental results of operating performance coincided successfully with the calculated values, and vacuum seal device proved its soundness after 10,000 operation of high speed pull-up. Operating ranges of prototype movable limiter are as follows: (1) Mass to be accelerated 235 kg (2) Max. acceleration + 70 G (3) Max. deceleration - 50 G (4) Max. stroke 1,070 mm (5) Max. limiter speed 14.5 m/s.

MAGNET COILS AND FIELDS

58066 (RL—77-131/A) **Development of superconductors for fusion technology.** Walters, C.R. (Science Research Council, Chilton (UK). Rutherford Lab.). Nov 1977. 54p. Dep. NTIS (US Sales Only), PC A06/MF A01.

The subject is dealt with under the headings: introduction and summary; A.C. losses; stability (adiabatic and dynamic stability, experimental stability in sheet superconductor, cryostatic stability); mechanical considerations (conductor design, toroidal coil shape, winding techniques); comparison of construction techniques.

58067 **Field line integration for MHD equilibria near a closed magnetic field line.** Lortz, D.; Nuehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). *Nucl. Fusion;* **18**: No. 6, 807-811(1978).

Magnetic field lines near a given closed field line which is taken as a magnetic axis are calculated analytically. Existence properties are obtained for equilibria whose rotational transform on a magnetic axis is an integer multiple of 1/2. The results are applied to a tokamak with a perturbation of the main field, the l=2 stellarator, the stability properties of equilibria with vanishing rotational transform, and the scaling of the equilibrium β-value in configurations without net longitudinal current and with small rotational transform.

58068 **Numerical simulation of strong proton rings.** Friedman, A.; Ferch, R.L.; Sudan, R.N. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Plasma Studies); Drobot, A.T. *Plasma Phys.;* **19**: No. 12, 1101-1117(Dec 1977).

Recent calculations suggest the possibility of achieving a Lawson breakeven condition by the magnetic compression of proton rings to field reversal. A physical model and computer code RING developed to study equilibria of strong proton rings and their behavior under an adiabatic increase in the external magnetic field are described. Ring ion motion is followed using a volume-weighted finite-size particle-in-cell method. Because of the very short electron time scale, the electrons are simulated by a simple fluid model using Ohm's law. Quasineutrality, current neutralization in the r-z plane, cylindrical symmetry and a magneto-static model are assumed. Preliminary results indicate that (a) equilibria tend to be intermediate between the long layer and bicycle tire cases; and (b) compression past field reversal on the axis is possible within the framework of this model. Some aspects of the formation and injection of proton rings have also been studied with this code.

58069 **Calculations of toroidal magnetic configuration with a spatial magnetic axis.** Ikeda, N. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch); Nagata, A. *Denshi Gijutsu Sogo Kenkyusho Iho;* **41**: No. 5, 361-379(May 1977). (In Japanese).

The magnetic fields with a modified spatial magnetic axis produced by the wavy theta-coil system arranged in a torus and the wavy l=1 helical coil system are calculated, and their complicated characteristics are examined. The results show that the magnetic lines of force have helical structure and considerable shear in the periphery of the plasma column which is favorable for improvement of the stability. The configuration shows a possibility of having the so-called "min B" when the current of the l=1 coil is large. Calculated values of the angles of magnetic lines of force agree extremely well with measured ones with a magnetic probe.

58070 **Dynamic analysis of electro-magneto-mechanical field by finite element method.** Miya, K. (Tokyo Univ. (Japan). Nuclear Engineering Research Lab.). *J. Fac. Eng., Univ. Tokyo, Ser. B;* **34**: No. 1, 137-157(Mar 1977).

As well-known in a structural design of controlled-thermonuclear reactor it is important and necessary to estimate magnet stress which is induced into structural components of it. Magnet stress is due to interaction between current density and magnetic field including interaction between magnetic field and magnetization. A strong magnetic field should be produced for the purpose of magnetic confinement of plasma and so the structural components should resist the magnet stress. The magnet stress is often induced in case the electro-magnetic field is transient. The transient field is particular to a Tokamak reactor of pulsed type. For the purpose of design of the controlled thermonuclear reactor numerical method of electro-magnetic-mechanical field analysis should be established. In the present paper finite element method is applied to transient Maxwell equations and equation of motion of conductor in order to make computer code. Three models are here employed and numerical results on them are shown.

POWER SUPPLIES, ENERGY STORAGE

58071 (UCRL—80578) **Fusion reactor requirements and systems for energy storage and transfer.** Thomassen, K.I.; Hagenson, R.L.; Thullin, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1978. Contract W-7405-ENG-48. 6p. (CONF-780508—26). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Energy storage and transfer requirements for many of the present day reactor systems are listed. Two ohmic heating (OH) requirements, those for toroidal Z-pinches and Tokamaks, are described in more detail. Technologies envisioned for the power conditioning circuitry are discussed.

COOLING SYSTEMS

58072 **Experimental study of bubble motion in mercury with and without a magnetic field.** Mori, Y.; Hijikata, K.; Kuriyama, I. (Tokyo Inst. of Tech.). *J. Heat Transfer;* **99**: No. 3, 404-410(Aug 1977).

The behavior and hydrodynamical performance of a single bubble rising through mercury with and without magnetic field has been studied experimentally. A new method to measure the rise velocity and the shape of bubble with an electrical triple probe is proposed. When there is no magnetic field, a bubble changes its shape from spherical to elliptic and then to a spherical cap shape, as its equivalent radius R/sub m/ changes from 0.1 to 3 mm. The experimental results are found to agree well with the theories reported so far. In the case of a magnetic field, it is found that the effect of intensity of magnetic field B on the rise velocity depends largely on the radius of a bubble. When R/sub m/ = 3 mm, the rise velocity decreases monotonically with the increase of B. However, when R/sub m/ = 1 mm, the rise velocity increases once but it then starts to decrease afterwards with the increase of B.

HEATING AND FUELING SYSTEMS

58073 (PPPL—1456) **Energetics of semi-catalyzed-deuterium, light-water-moderated, fusion-fission toroidal reactors.** Jassby, D.L.; Towner, H.H.; Greenspan, E.; Schneider, A.; Misolovin, A.; Gilai, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1978. Contract EY-76-C-02-3073. 13p. (CONF-780508—64). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

The semi-catalyzed-deuterium Light-Water Hybrid Reactor (LWHR) comprises a lithium-free light-water-moderated blanket with U_3Si fuel driven by a deuterium-based fusion-neutron source, with complete burn-up of the tritium but almost no burn-up of the helium-3 reaction product. A one-dimensional model for a neutral-beam-driven tokamak plasma is used to determine the operating modes under which the fusion energy multiplication Q/sub p/ can be equal to or greater than 0.5. Thermonuclear, beam-target, and energetic-ion reactions are taken into account. The most feasible operating conditions for Q/sub p/ approximately 0.5 are <n/sub e/>tau/sub E/ = 2 to 4 x 10^{14} $cm^{-3}s$, <T/sub e/> = 10 to 20 keV, and E/sub beam/ = 500 to 1000 keV, with approximately 40% of the fusion energy produced by beam-target reactions. Illustrative parameters of LWHRs are compared with those of an ignited D-T reactor.

58074 **Hydrogen pellet-rotating plasma interaction: a spectroscopic analysis.** Joergensen, L.W.; Sillesen, A.H.; Oester, F. (Research Establishment Risoe, Roskilde (Denmark)). *Plasma Phys.;* **19**: No. 12, 1093-1099(Dec 1977).

Spectroscopic measurements on the interaction between solid hydrogen pellets and rotating plasmas are reported. It was found that the light emitted is specific to the pellet material, and that the velocity of the ablated H-atoms is of the order of 10^4 m/s. The investigation was carried out with a view to the possible refuelling of fusion reactors by the injection of pellets.

58075 **Cyclotron masers (gyrotrons) as potent millimetre-wave sources.** Hirshfield, J.L. (Yale Univ., New Haven, Conn. (USA));

Granatstein, V.L. *Comments Plasma Phys. Controlled Fusion;* **3**: No. 3, 87-93(1977).

The theoretical and experimental development of cyclotron maser devices is described. The power and efficiency levels are already well in excess of that available from competing devices in the millimetre range and applications in plasma heating and in millimetre-wave radar are in progress.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 57963, 57969

58076 (CONF-7706130—, pp 29p, Session 4, Paper 3) **Prospects for laser fusion power.** Stickley, C.M. (Energy Research and Development Administration, Washington, DC). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

An outline of the research program structure is given. Some requirements for inertial confinement fusion are described. Future directions of the research program are considered. (MOW)

58077 (CONF-7706130—, pp 19p, Session 5, Paper 4) **Laser-fusion-power concepts.** Gomberg, H.J. (KMS Fusion, Inc., Ann Arbor, MI). 1977.

From Conference on U.S. options for long term energy supply; Denver, CO, USA (19 Jun 1977).

In U.S. options for long-term energy supply.

The development of small laser-fusion power plants rather than large plants is emphasized. The direct conversion of laser-fusion energy to chemical energy through radiolytic—thermochemical cycles is described. (MOW)

58078 (LLL-MISC—111) **NOVA. CP and D final report. Laser Fusion Program.** Gilmartin, T.J.; Godwin, R.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1978. Contract W-7405-ENG-48. 242p. Dep. NTIS, PC A11/MF A01.

This document is subdivided into the following sections: (1) project description, (2) laser system design, (3) optics, (4) mechanical systems, (5) power conditioning, (6) alignment, control, and beam diagnostics, (7) target systems, (8) building construction, (9) project management, (10) cost and schedule, and (11) supporting documents. (MOW)

58079 (SAND—78-0110C) **Design of compact particle-beam-driven inertial-confinement fusion reactors.** Cook, D.L.; Sweeney, M.A. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA, 9 May 1978.

The possibility of designing compact fusion reactor systems using highly-efficient particle beam drivers has been investigated. Analyses of the principal criteria which govern the design of particle-beam-driven reactors (PBDR) have indicated the feasibility of small (R less than 3m) reactor systems of the 100 MWe class which could operate with low pellet yields (Y approximately 30 MJ) and moderate recirculating power fraction (f approximately .25). This paper discusses PBDR design criteria and points out differences between laser-driven and particle-beam-driven reactors.

58080 (UCRL—80875) **Absorption and profile modification on spherical targets for .25 < λ < 2 microns.** Larsen, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Apr 1978. Contract W-7405-ENG-48. 48p. (CONF-780461—2). Dep. NTIS, PC A03/MF A01.

From 8. conference on anomalous absorption of electromagnetic waves; Tucson, AZ, USA (19 Apr 1978).

LASNEX calculations for focused laser beams on spherical targets have been performed for laser wavelengths of 0.25, 0.5, 1.0 and 2.0 microns. One-dimensional calculations, including the ponderomotive force, show a profile steepening that determines the fractional absorption by anomalous mechanism. However, increased absorption occurs at the shorter wavelengths because of more efficient inverse bremsstrahlung absorption at the higher critical densities. In general, the absorption efficiency increases with shorter laser wavelength and decreases with increasing f-number of the illuminating optics for sufficiently long plasma scale lengths. The effect of the absorption and laser wavelength on the thermal and superthermal electron physics will be discussed along with the combined effects on the implosion performance. Certain aspects of two-dimensional LASNEX calculations are presented.

58081 **Characterization of electron and ion current flow in very large aspect-ratio terawatt diodes employing heated and unheated anodes.** Genuario, R.D.; Bailey, V.L. (Physics International Company, San Leandro, California 94577). *Appl. Phys. Lett.;* **33**: No. 8, 694-696(15 Oct 1978).

Electron-beam-focusing experiments using tapered hollow cathodes have been performed at power levels exceeding 10^{12} W and with diode aspect ratios (radius/anode-cathode spacing) of 24 and 45 (uncorrected for plasma motion). The spatial distributions of both the electron (using collimated p-i-n diodes) and ion currents (using quartz pressure gauges and Faraday cups) were measured simultaneously. Efficient electron-beam pinches were produced at large R/d (≃24) using a diode configuration that employed a small-diameter cathode and heated anode.

58082 **Effect of electrode shielding on beamlet-beamlet interaction in multiaperture sources.** Whealton, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Appl. Phys. Lett.;* **33**: No. 8, 697-698(15 Oct 1978).

Extension of previous work on beamlet-beamlet interaction is made in two phases. The effect of beam space-charge truncation due to electrode shielding is considered. For a typical geometry multiaperture source, the ion divergence is thus reduced by a factor of 30, assuming all the beamlets interact with each other, and by a factor of 5, assuming only nearest-neighbor beamlets interact. To account accurately for electrode shielding, a direct solution to the Poisson-Vlasov equation was made for a similar physical situation. For a typical circumstance it shows an additional decrease of a factor of 5 for both the global and nearest-neighbor calculation. These results indicate that beamlet-beamlet interaction is small for typical ion sources.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

58083 (SAND—78-0619C) **Low energy hydrogen and deuterium sputtering measurements of stainless steel, graphite, and beryllium oxide.** Borders, J.A.; Langley, R.A.; Wilson, K.L. (Sandia Labs., Albuquerque, NM (USA); Sandia Labs., Livermore, CA (USA)). 1978. Contract EY-76-C-04-0789. 19p. (CONF-780431—15). Dep. NTIS, PC A02/MF A01.

From 3. conference on plasma interaction in controlled fusion devices; Abingdon, Oxfordshire, UK (3 Apr 1978).

The total erosion yields of 304 stainless steel by low energy hydrogen and deuterium have been determined by ^{4}He ion backscattering spectroscopy at energies ranging from 0.33 to 9.0 keV. This experimental method determines the number of atoms removed by sputtering by measuring the change in depth of implanted Xe marker atoms. Data for 304 stainless steel are compared with the extensive published data obtained using the weight loss technique. The Xe marker method is used to make the first measurements of deuterium erosion on polycrystalline graphite. Deuterium erosion measurements of thermally-prepared oxide layers on Be were also made using ^{4}He backscattering spectroscopy to determine directly the number of removed atoms. These new data for the sputtering yields of deuterium on carbon and BeO range from 0.016 to 0.052 atoms per ion.

58084 **Use and performance of graphite and metal ISSECS in tokamak fusion reactors.** Avci, H.I.; Gohar, Y.; Sung, T.Y.; Kulcinski, G.L.; Maynard, C.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Nucl. Eng. Des.;* **45**: No. 2, 285-310(Feb 1978).

Carbon and the metallic elements molybdenum, niobium, vanadium and tungsten have been considered for use as an ISSEC (International Spectral Shifter and Energy Converter) in tokamak fusion reactors. All five materials have been shown to reduce the radiation damage in the 316 SS structural first wall and thus increase the first wall lifetime. On a per unit thickness basis, a tungsten ISSEC is most effective in this regard follwed by Mo, Nb, V and carbon ISSECS in decreasing order. Among the four metals studied, Mo is considered to be the best material for use as an ISSEC. A definitive choice between a graphite and Mo ISSEC is difficult at this time as both materials have strong positive features; carbon being superior from radioactivity, afterheat, cost and fabricability standpoint, but Mo being more effective in reducing the radiation damage in the first structural wall and increasing the energy multiplication in the blanket.

58085 **Shell current and vertical field due to it in a tokamak model shell.** Sometani, T.; Hasebe, K. (Shizuoka Univ., Hamamatsu (Japan). Faculty of Engineering); Fujisawa, N. *Jpn. J. Appl. Phys.;* **16**: No. 8, 1343-1348(Aug 1977).

The distribution of the image current in a model shell containing a plasma simulator has been measured. The shell current increases as the simulator moves outwards, and as the frequency of the simulator current increases. The deviation from a dipolar distribution of the shell current becomes more pronounced as the simulator moves inwards. When the frequency is raised to make the skin depth of the shell smaller than the thickness of the shell, the strength of the shell current becomes essentially independent of the frequency. The measured vertical field due to the shell current agrees with the vertical field calculated with the measured shell current.

GENERAL AND MISCELLANEOUS

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 57498

58086 (CONF-780802—5) **Statistics in non-normal sampling.** Bowman, K.O.; Shenton, L.R. (Georgia Univ., Athens (USA)). [nd]. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From American Statistical Association meeting; San Diego, CA, USA (14 Aug 1978).

There are still a number of outstanding distributional problems relating to well-known statistics (standard deviation, t, F, etc.) under nonstandard conditions. Formidable problems exist if exactness is the main aim. Approximate methods are of many kinds, depending on the statistic involved. Preliminary studies of an approach using series for low-order moments followed by fitting an approximating distribution have been made. Since the moment series appear to be divergent, summation algorithms are used. Recently an algorithm of Levin [Intern. J. Computer Math., Sec. B, v.3, 371-88 (1973)] was successfully applied to the moments of the standard deviation in sampling from exponential, logistic, rectangular, and half-Gaussian populations. The application of the Levin algorithm to the distribution of t in sampling from chi²-type populations is discussed. In particular, sampling is from G(rho), where this is the density g(x, rho) = e/sup -x/x/sup rho-1//GAMMA(rho), for x, rho > 0. The statistic considered is $t^* = (m'_1 - \mu'_1)/\sqrt{m_2}$, with m'_1 = sample mean, m_2 = sample second central moment. (G(1) is the exponential itself.) The effect of different stopping rules for Levin's algorithm and G(1) sampling is considered. 5 tables. (RWR)

58087 (COO—1198-1215) **FORTRAN programs for data fitting using orthogonal polynomials.** Gibson, B.C. (Illinois Univ., Urbana (USA)). May 1978. Contract EY-76-C-02-1198. 44p. Dep. NTIS, PC A03/MF A01.

The use of orthogonal functions in least-squares data fitting is discussed, and a FORTRAN subroutine (ORFIT) which uses orthogonal polynomials in data fitting is presented. Also described are two FORTRAN programs for fitting data which use the subroutine ORFIT. The first one, FIT, is a general-purpose data fitting program. The second one, TFIT, is specifically intended for use in calibrating cryogenic germanium resistance thermometers. TFIT fits lnT to a polynomial in lnR (where T and R are the temperature and resistance, respectively).

58088 (LA-UR—78-1660) **Event and effectiveness models for simulating computer security.** Schelonka, E.P. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 9p. (CONF-780910—1). Dep. NTIS, MF A01.

From IEEE Computer Society Conference; Washington, DC, USA (5 Sep 1978).

Portions of document are illegible.

The development and application of a series of simulation codes (designated SECSIM) that are used for computer security analysis and design are described. Individual barrier characteristics are incorporated into generalized architectural reduction algorithms providing numerical indices in selected subcategories and for the system as a whole. 7 figures, 13 tables.

58089 (LA-UR—78-1785) **Program called ANAMINT.** Prueitt, M.L. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 4p. (CONF-780908—1). Dep. NTIS, PC A02/MF A01.

From Conference on interactive techniques in computer aided design; Bologna, Italy (21 Sep 1978).

ANIMINT is a FORTRAN computer program which produces animated movies interactively. The user enters data at a Tektronix terminal on a graphics tablet and observes the images on the terminal screen. The final result is a 16-mm color movie. The program is fast and uses a minimum of computer memory. It was designed to minimize user effort in producing a high-quality animated film. 2 figures.

58090 (PNL-SA—6950) **Pacific Northwest Laboratory minicomputer network.** Gerhardstein, L.H.; Schroeder, J.O.; Boland, A.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 15p. (CONF-780828—2). Dep. NTIS, PC A02/MF A01.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

The Pacific Northwest Laboratory (PNL) uses a multitude of minicomputers for real-time data acquisition, data reduction and analysis, graphics, data base management, and time-sharing. Applications include a wide range of scientific and administrative disciplines. As in any institution where multiple computing facilities exist, there comes a time when a data communication network ceases to be a luxury and becomes a necessity. Computer systems engineers at PNL have been considering the networking problem. This paper describes the network being developed at PNL. The network is called "BATNET." BATNET employs broadcast communication over a shared communication channel and carrier-sense-multiple-access (CSMA) protocol. CSMA protocol has been implemented in software. The computer interfaces perform necessary CSMA logical functions such as busy detection, collision detection, and timing for retransmission scheduling. The present BATNET configuration has five stations, all PDP-11's. However, it can be implemented for virtually unlimited stations and on other manufacturer's mini/microcomputers. The BATNET protocol can be implemented on any minicomputer with 8- or 16-bit integer data modes. Low-level input/output handlers should be written in machine-dependent assembly language or in higher-level system languages when they are available. Most high-level system routines will be written in system-independent FORTRAN IV to maintain source program transportability. The present plans call for multiple local networks tied together through dedicated relay stations with gateway processors for offsite data communication. BATNET uses electronic transceivers and 75-ohm coaxial transmission line. Future development will consider the use of fibre-optical devices, microwave, and vhf/uhf short-range radio.

58091 (RE-A—78-049) **User's guide to ANYOLS: a regression program allowing many ways to select a model.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1978. Contract EY-76-C-07-1570. 33p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

Program package ANYOLS allows the user to fit one or more ordinary least squares regression models in a stepwise or predetermined way. Possible stepwise selection criteria are: F, s², MSE (from C/sub p/) and PRESS. Possible predetermined ways are: to get all possible regressions and to get all possible regressions which include the first variable. Other ways may be specified by a user-written subroutine. User control of input, variable selection criteria and output is through short user-written FORTRAN subroutines.

58092 (SAND—78-0450) **Numerical inversion of Laplace transforms.** Amos, D.E. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 81p. Dep. NTIS, PC A05/MF A01.

Approximate formulas in the form of Gauss-type quadrature rules can be written for the complex inversion integral associated with the Laplace transform. Weights and roots are tabulated for up to 30 points. Numerical examples from wave propagation and diffusion illustrate the usage. If the transform comes from an initial-value problem, the inversion can be obtained to arbitrary accuracy by application of the formula in steps. The method of lines for the wave and heat equation using the Gauss formula is analyzed for numerical stability. 14 figures, 3 tables.

58093 (SAND—78-0762) **COCOMP type best-fitting in three dimensions.** Halpin, W.J. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 55p. Dep. NTIS, PC A04/MF A01.

This report describes analyses of "least squares" COCOMP-type fitting in three dimensions. Equati¯ons that represent necessary conditions for an exact solution are derived but are not solved. A method for an approximate solution based on these equations is outlined. Several methods of arriving at a solution by iteration, at least one of which appears to give very accurate results, are also outlined. 8 figures, 5 tables.

58094 (SAND—78-0826) **Sandia File Save System documentation program.** Quinlan, G.F. (Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-76-C-04-0789. 73p. Dep. NTIS, MF A01.

Includes listing of system program. Portions of document are illegible.

The Sandia File Save System is a set of programs which, when used in conjunction with a specially modified SECURE processor, maintain a set of backup magnetic tape reels which contain current copies of all files on fixed disk storage. The programs examine the current copy of the EXEC-8 Master File Directory (MFD) and format source language for processing by UNIVAC's SECURE Processor. The source language causes SECURE to save all files which have been altered since the last save to available reels within a dedicated pool of tapes. The system also initiates maintenance functions on the tape pool, such as compression, error analysis, and usage reporting. 11 figures.

58095 (SAND—78-1266) **Solving systems of linear equations and inequalities.** Hiebert, K.L. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

A direct approach for solving systems of linear equations and inequalities is presented. The proposed algorithm is described, and convergence analysis is given. Numerical examples help elucidate the workings of the algorithm. The new approach is compared with other methods for solving linear inequalities. (RWR)

58096 (SAND—78-1442) **SLINEQ: a code to solve systems of linear equations and inequalities.** Hiebert, K.L. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC E02/MF E02.

This report describes the code SLINEQ, which determines whether or not a system of linear equations and inequalities is consistent and, if consistent, calculates a solution (feasible point) to it. This problem often occurs as a subproblem to a constrained optimization problem when the technique used to solve the optimization problem requires an initial feasible point. Included in this report are a short user's guide to the code, example calling program, the results of testing designed to determine the efficiency and reliability of SLINEQ, and a listing of both the FLECS and FORTRAN versions of the code. 6 figures, 1 table. (RWR)

58097 (UCID—17862) **BICUBE: bicubic spline interpolation code.** Dickinson, R.P. Jr.; Carlson, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

BICUBE is a program for constructing a bicubic spline surface through a given set of data points defined over a rectangular grid. In this sense BICUBE is a program for solving the 2-dimensional smooth surface interpolation problem. A brief discussion of bicubic spline interpolation is given first. Then a detailed description of the structure of BICUBE is provided, and the calling sequences of the principal subroutines are explained. Finally, an example of the use of BICUBE is given. 4 figures. (RWR)

58098 (UCID—30045(Rev.1)) **Solution of banded linear systems.** Hindmarsh, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 36p. Dep. NTIS, PC A03/MF A01.

This report describes four subroutine packages, each of which carries out the direct solution of a system of linear equations for which the coefficient matrix is real and banded along the main diagonal. In each, the method of LU decomposition (without pivoting) is applied to the matrix; the solution is then obtained by backsubstitution in a separate routine. The general case and the symmetric case are treated separately. For each of these, the case where the matrix resides entirely within core and the case where it resides in Large Core Memory are treated separately. This report supersedes the original report UCID-30045, dated May 1972. This revised report reflects changes made to the subroutine packages given herein, and corresponding changes to their usage instructions. The algorithms used have not been altered. 3 figures.

58099 (UCRL—52472) **PIECHART: a computer program that draws PIECHARTS in color.** Keller, P.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1978. Contract W-7405-ENG-48. 45p. Dep. NTIS, PC A03/MF A01.

PIECHART constructs professional-quality piecharts in color for reports and presentations. It offers automatic picture layout. The slices of the pie may be labeled, textured, or colored to identify classes of data. The use of PIECHART on the CDC 7600 computers of the Livermore timesharing system is explained. 4 figures, 2 tables.

58100 **Unified radon inversion formula.** Deans, S.R. (Donner Laboratory, Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Math. Phys. (N.Y.);* **19**: No. 11, 2346-2349(Nov 1978).

A Radon inversion formula which holds in spaces of even or odd dimension n is obtained for functions which admit to a certain general decomposition. The inversion formula which is one member of a Gegenbauer transform pair is used to generate some interesting definite integrals involving special functions. Legendre and Tchebycheff transform pairs are discussed as special cases of the general result.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 57533

58101 (CONF-780483—1) **Common communication format for bibliographic data exchange.** Gove, N.B.; Hughes, T.E.; Matiushin, G.D.; Turtanov, N.V. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 31p. Dep. NTIS, MF A01.

From Symposium on bibliographic exchange formats; Sicily, Italy (27 Apr 1978).

Portions of document are illegible.

Development of a format for use in the exchange of machine-readable bibliographic information between the USA and the USSR is discussed. ISO standards will be used, where relevant, for carrier format and character codes. Extensions to UNIMARC are proposed for content designators to accommodate the needs of abstracting and indexing services. A common listing format, including a transliteration scheme, was developed for test and check purposes. 7 figures, 3 tables.

58102 (TID—7000-R3) **Energy information data base. Subject thesaurus.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1978. 709p. Dep. NTIS, PC A99/MF A01.

The technical staff of the DOE Technical Information Center, during its subject indexing activities, develops and structures a vocabulary that allows consistent machine storage and retrieval of information necessary to the accomplishment of the DOE mission. This thesaurus incorporates that structured vocabulary. The terminology of this thesaurus is used for the subject control of information announced in DOE Energy Research Abstracts, Energy Abstracts for Policy Analysis, Solar Energy Update, Geothermal Energy Update, Fossil Energy Update, Fusion Energy Update, Energy Conservation Update, and Power Reactor Docket Information (published for the Nuclear Regulatory Commission). This terminology also facilitates subject searching of the DOE technical information data base, a research in progress data base describing energy-related research, and a general and practical energy information data base on the DOE on-line retrieval system, RECON. The rapid expansion of DOE's activities will result in a concomitant thesaurus expansion as information relating to new activities is indexed. Only the terms used in indexing documents at the Technical Information Center to date are included. (RWR)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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CAES-		
462-A-77	3:57139	Dep. NTIS, PC A08/MF A01
504-78	3:57140	Dep. NTIS, PC A05/MF A01
CEEDO-TR-		
77-39	3:56696	*See* AD-A-049490
CEL-TR-		
859	3:56712	*See* AD-A-049552
CENPD-		
141(Rev.2)	3:57036	Combustion Engineering, Inc., Windsor, CT
CERL-IR-E-		
120	3:57117	*See* AD-A-051074
CMR-		
78-2	3:57318	*See* AD-A-049858
CONF-7504140-	(Meeting of the Institute of Petroleum/field studies council, Aviemore, UK, 21-23 Apr 1975)	
	3:57572	New York; John Wiley and Sons Inc. (1976). $60.00
CONF-7508106-	(Consumer energy workshop, Kansas City, MO, USA, 8 Aug 1975)	
(Summ.)	3:57138	Dep. NTIS, PC A01/MF A01
CONF-760580-	(Symposium on populations of small mammals under natural conditions, Linesville, PA, USA, 14-16 May 1976)	
P5	3:57539	Pittsburgh; Univ. of Pittsburgh (1978).
CONF-7610109-	(25. congress and plenary assembly of CIESM, Split, Yugoslavia, 22-30 Oct 1976)	
3	3:56787	Dep. NTIS (US Sales Only), PC A02/MF A01
CONF-770159-	(Properties and characteristics of high-level waste glass, Washington, DC, USA, 4-5 Jan 1977)	
1	3:56633	*See* BNWL-SA-6146
CONF-770253-	(Flat-plate solar collector conference, Orlando, FL, USA, 28 Feb-2 Mar 1977)	
	3:56736	*See* FSEC-77-8
CONF-770403-	(39. annual meeting of the American Power Conference, Chicago, IL, USA, 18-20 Apr 1977)	
	3:56391	39: 327-335(1977)
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	3:56882	Chicago; Illinois Inst. of Technology (1977). $30.00
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	3:57141	39: 735-743(1977)
	3:57142	39: 765-773(1977)
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CONF-770523-	(Symposium on neutron cross sections 10-40 MeV, Upton, NY, USA, 3-5 May 1977)	
	3:57812	*See* BNL-NCS-50681
CONF-7705120-	(Offshore technology conference, Houston, TX, USA, 2-5 May 1977)	
P1	3:56475	David L. Riley, Executive Manager, Offshore Tech. Conference, 6200 N. Central Expressway, Dallas, TX
P2	3:56476	David L. Riley, Offshore Technology Conference, 6200 N. Central Expway, Dallas, TX
P3	3:56477	David L. Riley, Offshore Technology Conference, 6200 N. Central Expressway, Dallas, TX
P4	3:56478	David L. Riley, Offshore Technology Conference, 6200 N. Central Expway, Dallas, TX

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CONF-7705131-		(3. coal refuse disposal and utilization seminar, Lexington, KY, USA, 11-12 May 1977)
1	3:56384	*See* IS-M-142
CONF-770656-		(Annual meeting of the Institute of Nuclear Materials Management, Washington, DC, USA, 29 Jun-1 Jul 1977)
29	3:56378	*See* IS-M-130
CONF-770698-		(Conference on boron in glass and glass ceramics, Alfred, NY, USA, 5-8 Jun 1977)
3	3:57242	Dep. NTIS, PC A02/MF A01
CONF-7706130-		(Conference on U.S. options for long term energy supply, Denver, CO, USA, 19-22 Jun 1977)
	3:57066	Atomic Industrial Forum, Inc., Washington, DC
CONF-770720-		(22. annual meeting of the Health Physics Society, Atlanta, GA, USA, 3-8 Jul 1977)
14	3:56663	*See* BNWL-SA-6121
15	3:57616	*See* Y/DD-225
CONF-770831-		(4. international conference on coal gasification, liquefaction and conversion to electricity, Pittsburgh, PA, USA, 4 Aug 1977)
2	3:56352	*See* TIS-5146
CONF-770847-		(15. international thermal conductivity conference, Ottawa, Ontario, Canada, 24-26 Aug 1977)
8	3:57189	*See* COO-2315-12
CONF-770909-		(International symposium on sulfur in the atmosphere, Dubrovnik, Yugoslavia, 7-14 Sep 1977)
3	3:57523	*See* BNWL-SA-6370
CONF-770921-		(3. biennial wind energy conversion systems conference, Washington, DC, USA, 19-21 Sep 1977)
P2	3:56814	Dep. NTIS, PC A21/MF A01
CONF-770949-		(International conference on low energy ion beams, Salford, UK, 5-8 Sep 1977)
	3:57699	The Institute, Publishing Division-Techno House, Redcliffe Way, Bristol, England
CONF-7709149-		(Symposium on land restoration after strip mining for coal, Juneau, AK, USA, 21 Sep 1977)
1	3:56392	*See* BNWL-SA-6525
CONF-7709151-		(Symposium on power plant heat rejection, Washington, DC, USA, 12-13 Sep 1977)
1	3:56894	*See* BNWL-SA-6506
CONF-771036-		(2. ASTM-EURATOM symposium on reactor dosimetry: dosimetry methods for fuels, cladding and structural materials, Palo Alto, CA, USA, 2-7 Oct 1977)
16	3:57026	*See* HEDL-SA-1309
CONF-771072-		(3. international conference on nuclear methods in environmental and energy research, Columbia, MO, USA, 10-12 Oct 1977)
8	3:57618	*See* BNWL-SA-6314
CONF-771102-		(20. annual AICHE meeting, New York, NY, USA, 13-17 Nov 1977)
25	3:56634	*See* BNWL-SA-6368
27	3:56635	*See* BNWL-SA-6564
CONF-771109-		(ANS winter meeting, San Francisco, CA, USA, 27 Nov-2 Dec 1977)
107	3:57221	*See* HEDL-SA-1335
109	3:57536	*See* PNL-SA-6720
CONF-771113-		(4. joint conference on sensing of environmental pollutants, New Orleans, LA, USA, 6-11 Nov 1977)
15	3:57254	*See* BNWL-SA-6263
CONF-771136-		(Annual American Physical Society meeting, Atlanta, GA, USA, 7-11 Nov 1977)
33	3:56673	*See* UCRL-79735(Rev.1)
CONF-780134-		(Symposium commemorating the 25th anniversary of the discovery of elements 99 and 100, Berkeley, CA, USA, 23 Jan 1978)
3	3:57294	*See* ORO-4447-074
CONF-780145-		(Orbis scientiae conference, Coral Gables, FL, USA, 15-20 Jan 1978)
1	3:57804	*See* SLAC-PUB-2089
CONF-780152-		(Meetings of the World Mariculture Society, Atlanta, GA, USA, 3-6 Jan 1978)
1	3:57604	Dep. NTIS, PC A02/MF A01
CONF-780153-		(Symposium on structural of wind turbines, Cleveland, OH, USA, 30 Jan 1978)
1	3:56870	*See* PNL-SA-6739
CONF-780222-		(5. energy technology conference, Washington, DC, USA, 27 Feb-1 Mar 1978)
7	3:57938	*See* PNL-SA-6492
CONF-780253-		(Eletrobras/sudene seminar, Recife, Brazil, 13-16 Feb 1978)
1	3:56822	*See* SAND-78-0548C
CONF-780333-		(Symposium on superheavy elements, Lubbock, TX, USA, 9-11 Mar 1978)
8	3:57884	*See* SLAC-PUB-2129
CONF-780338-		(3. conference on new results in high energy physics, Nashville, TN, USA, 6-8 Mar 1978)
4	3:57736	*See* SLAC-PUB-2120
CONF-780340-		(Conference on utilization of methane generating in land fills, Laurel, MD, USA, 9-10 Mar 1978)
	3:56681	Dep. NTIS, PC A03/MF A01
CONF-780347-		(Symposium on composite materials: testing and design, New Orleans, LA, USA, 20-22 Mar 1978)
1	3:57239	*See* SAND-78-0412C
CONF-780350-		(Solar thermal central power systems semi-annual review, San Diego, CA, USA, 2-3 Mar 1978)
1	3:56782	*See* SAND-78-0432C
CONF-780366-		(18. symposium on archaeometry and archaeological prospection, Bonn, F.R. Germany, 14-17 Mar 1978)
1	3:57293	*See* BNL-24570
CONF-780367-		(2. waste heat aquaculture workshop, New Brunswick, NJ, USA, 29-31 Mar 1978)
1	3:57143	Dep. NTIS, PC A02/MF A01
CONF-780368-		(Symposium on freshwater wetlands, Tallahassee, FL, USA, 2 Mar 1978)
1	3:57565	*See* BNL-24611
CONF-780401-		(Topical meeting on advances in reactor physics, Gatlinburg, TN, USA, 9-12 Apr 1978)
11	3:57002	Dep. NTIS, MF A01
CONF-780407-		(Symposium on design, construction and operating experience of demonstration liquid metal fast breeder reactors, Bologna, Italy, 10-14 Apr 1978)
7	3:57012	*See* BNWL-tr-335
CONF-780431-		(3. conference on plasma interaction in controlled fusion devices, Abingdon, Oxfordshire, UK, 3-7 Apr 1978)
15	3:58083	*See* SAND-78-0619C
CONF-780461-		(8. conference on anomalous absorption of electromagnetic waves, Tucson, AZ, USA, 19-21 Apr 1978)
2	3:58080	*See* UCRL-80875
CONF-780480-		(Workshop on current problems in particle physics, Baltimore, MD, USA, 21-22 Apr 1978)
1	3:57800	*See* LA-UR-78-1344
CONF-780483-		(Symposium on bibliographic exchange formats, Sicily, Italy, 27-29 Apr 1978)
1	3:58101	Dep. NTIS, MF A01
CONF-780484-		(3. automated inspection and product control conference, Nottingham, UK, 11-14 Apr 1978)
1	3:57380	*See* BNWL-SA-6088(Rev.)
CONF-780488-		(6. conference on automated cytology, Elmau, F.R. Germany, 23-29 Apr 1978)
3	3:57592	*See* LA-UR-78-1624
CONF-780490-		(13. colloquium on polluted atmospheres, Paris, France, 25-28 Apr 1978)
1	3:57527	*See* LBL-7832
CONF-780492-		(Conference on control of hazardous material spills, Miami Beach, FL, USA, 10-14 Apr 1978)
1	3:57571	*See* PNL-SA-6814
CONF-780508-		(3. meeting on the technology of controlled thermonuclear fusion, Santa Fe, NM, USA, 9-11 May 1978)
26	3:58071	*See* UCRL-80578
54	3:58052	*See* UWFDM-249
57	3:58059	*See* UWFDM-246
64	3:58073	*See* PPPL-1456
CONF-780546-		(Seminar on nuclear data problems for thermal reactor applications, Upton, NY, USA, 22-24 May 1978)

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5	3:57890	*See* LA-UR-78-1846
CONF-780550-	(Seminar on testing solar energy materials and systems, Washington, DC, USA, 22-24 May 1978)	
5	3:56713	Dep. NTIS, PC A02/MF A01
CONF-780552-	(Conference on plasma science, Monterey, CA, USA, 15-17 May 1978)	
3	3:57963	*See* UCRL-81099
CONF-780579-	(Meeting on picosecond phenomena, Hilton Head, SC, USA, 24-26 May 1978)	
4	3:57602	*See* LA-UR-78-1767
CONF-780585-	(IEEE workshop on small toroidal plasma devices, Monterey, CA, USA, 18 May 1978)	
1	3:58051	*See* COO-2456-55
CONF-780599-	(CAES technology symposium, Pacific Grove, CA, USA, 15-17 May 1978)	
3	3:57046	Dep. NTIS, PC A03/MF A01
CONF-7805107-	(International magnetics conference, Florence, Italy, 9-12 May 1978)	
1	3:57473	*See* UCRL-80811
CONF-7805113-	(IIASA workshop, Vienna, Austria, 2-4 May 1978)	
1	3:56632	*See* UCRL-81060
CONF-780606-	(Institute of Nuclear Materials Management meeting, Cincinnati, OH, USA, 27-29 Jun 1978)	
16	3:56629	*See* LA-UR-78-1652
CONF-780609-	(ASME/CSME pressure vessels and piping conference, Montreal, Canada, 25-29 Jun 1978)	
6	3:57158	Dep. NTIS, MF A01
8	3:57176	Dep. NTIS, PC A03/MF A01
11	3:57009	*See* HEDL-SA-1469
CONF-780611-	(AIChE symposium, Philadelphia, PA, USA, 4-8 Jun 1978)	
8	3:56332	Dep. NTIS, PC A03/MF A01
9	3:56333	Dep. NTIS, MF A01
10	3:57530	*See* PNL-SA-6721
13	3:56452	*See* IS-M-147
CONF-780612-	(Symposium on advances in radiation protection monitoring, Stockholm, Sweden, 26-30 Jun 1978)	
7	3:57484	*See* LA-UR-78-1555
CONF-780619-	(IEEE photovoltaic specialists conference, Washington, DC, USA, 5-8 Jun 1978)	
10	3:56700	*See* DOE/NASA/1022-78/31
CONF-780622-	(ANS annual meeting, San Diego, CA, USA, 18-23 Jun 1978)	
64	3:57888	*See* HEDL-SA-1495-FP
CONF-780623-	(International federation of automatic control, VII world congress, Helsinki, Finland, 12-16 Jun 1978)	
1	3:56727	*See* LA-UR-77-1048
CONF-780650-	(1. symposium on ultrasonic materials characterization, Gaithersburg, MD, USA, 7-9 Jun 1978)	
1	3:57195	*See* Y/DA-7750
CONF-780657-	(23. meeting of the Health Physics Society, Minneapolis, MN, USA, 18-23 Jun 1978)	
2	3:57533	*See* DPSPU-78-30-11
3	3:57307	*See* DPSPU-78-30-12
CONF-780667-	(Symposium on solar energy, Cairo, Egypt, 16-22 Jun 1978)	
2	3:56728	*See* LA-UR-78-1263
CONF-780669-	(Specialist meeting, Boekelo, Netherlands, 27-29 Jun 1978)	
1	3:56615	*See* K/P-6452
CONF-780679-	(JOPWOG-6/SubWOG-268 meeting, Albuquerque, NM, USA, 27-30 Jun 1978)	
1	3:57302	*See* SAND-78-1310C
4	3:57632	*See* UCRL-81366
CONF-780682-	(41. meeting of the American Society of Limnology and Oceanography, Victoria, BC, Canada, 19-22 Jun 1978)	
1	3:57570	*See* PNL-SA-6683
CONF-780685-	(Symposium on nonlinear structure and dynamics in condensed matter, Oxford, UK, 27-29 Jun 1978)	
2	3:58032	*See* PPPL-1455
CONF-780696-	(4. biennial Rocky Mountain meeting, Boulder, CO, USA, 5 Jun 1978)	
1	3:57260	*See* RFP-2756
CONF-780697-	(4. conference on the pneumatic transport of solids in pipes, Carmel, CA, USA, Jun 1978)	
1	3:56620	*See* GA-A-14705
CONF-7806100-	(5. symposium on mass spectrometer in biochemistry and medical, Rimini, Italy, 19-21 Jun 1978)	
1	3:57581	Dep. NTIS, PC A02/MF A01
CONF-780706-	(6. pyrotechnics seminar, Estes Park, CO, USA, 17-21 Jul 1978)	
7	3:57225	*See* MLM-2531(OP)
12	3:57511	*See* SAND-78-1384C
15	3:57509	*See* MLM-2551(OP)
16	3:57245	*See* MLM-2550(OP)
CONF-780708-	(Geothermal Resources Council meeting, Hilo, HI, USA, 25-28 Jul 1978)	
5	3:56794	*See* LA-UR-78-907
7	3:56790	*See* SAND-78-0668C
11	3:56789	*See* SAND-78-0443C
12	3:56791	*See* UCRL-80945(Rev.1)
12	3:56799	*See* LA-UR-78-906
13	3:56798	*See* LA-UR-78-904
15	3:56796	*See* SAND-78-0669C
18	3:56797	*See* SAND-78-0670C
19	3:56793	*See* LBL-7040
20	3:56795	*See* SAND-78-0598C
CONF-780710-	(22. American Association of Cost Engineers meeting, San Francisco, CA, USA, 9-12 Jul 1978)	
4	3:56935	Dep. NTIS, PC A02/MF A01
CONF-780712-	(Conference on numerical methods in laminar and turbulent flow, Swansea, UK, 18-21 Jul 1978)	
5	3:57377	*See* SAND-78-1360C
7	3:57378	*See* UCRL-81323
CONF-780718-	(7. cryogenic engineering conference, South Kensington, London, UK, 4-7 Jul 1978)	
3	3:57482	*See* LBL-7258
CONF-780720-	(1. otto schott symposium, Jena, D.D.R., F.R. Germany, 10-14 Jul 1978)	
1	3:57229	*See* UCRL-81168
CONF-780722-	(9. symposium on effects of radiation in structural materials, Richland, WA, USA, 10-14 Jul 1978)	
1	3:57219	Dep. NTIS, PC A02/MF A01
4	3:57027	*See* HEDL-SA-1461
CONF-780723-	(4. underground coal conversion symposium, Steamboat Springs, CO, USA, 17-20 Jul 1978)	
1	3:56353	*See* UCRL-81267
3	3:56350	*See* SAND-78-1317C
4	3:56354	*See* UCRL-81271
CONF-780731-	(Symposium on grain elevator explosions, Washington, DC, USA, 11-12 Jul 1978)	
1	3:57631	*See* IS-EMRRI-8
CONF-780734-	(Workshop on analytical electron microscopy, Ithaca, NY, USA, 24-28 Jul 1978)	
1	3:57496	Dep. NTIS, PC A02/MF A01
CONF-780739-	(3. conference on permafrost, Edmonton, Alberta, Canada, 10-13 Jul 1978)	
1	3:57513	*See* UCRL-78962
CONF-780740-	(Management, stabilization, and environmental impact of uranium mill trailings, Albuquerque, NM, USA, 24-28 Jul 1978)	
2	3:57532	Dep. NTIS, PC A02/MF A01
CONF-780741-	(Frontiers of biological energetics; electrons to tissues, Philadelphia, PA, USA, 19-21 Jul 1978)	
1	3:57580	Dep. NTIS, PC A02/MF A01
CONF-780745-	(Conference on effluent and environmental radiation surveillance, Johnson, VT, USA, Jul 1978)	
1	3:57576	Dep. NTIS, PC A02/MF A01
CONF-780801-	(13. intersociety energy conversion engineering conference, San Diego, CA, USA, 20-25 Aug 1978)	
22	3:57049	*See* SAND-78-8505
23	3:56868	*See* DOE/NASA/1004-78/13
CONF-780802-	(American Statistical Association meeting, San Diego, CA, USA, 14-17 Aug 1978)	
4	3:57119	Dep. NTIS, PC A02/MF A01
5	3:58086	Dep. NTIS, PC A02/MF A01
CONF-780804-	(13. congress on high-speed photography and photonics, Tokyo, Japan, 20-25 Aug 1978)	
5	3:57961	*See* UCRL-80922
7	3:57962	*See* UCRL-80923(Rev.1)
CONF-780805-	(6. heat transfer conference, Toronto, Canada, 7-11 Aug 1978)	

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4	3:56349	*See* SAND-77-0638C
CONF-780806-		(17. symposium on combustion, Leeds, UK, 20-25 Aug 1978)
2	3:57514	*See* UCRL-80435
CONF-780811-		(7. conference on plasma physics and control, Innsbruck, Austria, 23-31 Aug 1978)
1	3:58009	*See* UCRL-81275
CONF-780813-		(Symposium on high pressures, Paris, France, 22-24 Aug 1978)
7	3:57505	*See* LA-UR-78-1062
8	3:57507	*See* LA-UR-78-1191
9	3:57508	*See* LA-UR-78-1219
10	3:57504	*See* LA-UR-78-836
CONF-780818-		(Electron microscopy conference, Toronto, Canada, 1-9 Aug 1978)
1	3:57495	*See* BNL-24054
2	3:57594	*See* UCRL-80753
5	3:57177	Dep. NTIS, PC A02/MF A01
CONF-780819-		(15. nuclear air cleaning conference, Boston, MA, USA, Aug 1978)
1	3:56640	*See* MLM-2537(OP)
2	3:56639	*See* MLM-2536(OP)
4	3:56643	*See* RFP-2768
14	3:56636	Dep. NTIS, MF A01
18	3:57531	*See* UCRL-81512
19	3:57471	*See* UCRL-80789
CONF-780820-		(1. conference on liquid atomization and spray systems, Tokyo, Japan, 28-31 Aug 1978)
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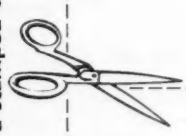

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